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ABSTRACT

This paper examines aspects of the knowledge content of work and its relationship with workers' education level and literacy skills. An executive summary appears in English and French. After an introduction, Chapter 2 classifies occupations into seven categories based on knowledge content of the work. Chapter 3 develops profiles of the prevalence in each occupational category of work activities--in particular those involving use of literacy skills--using data from the Canadian sample of the International Adult Literacy Survey (IALS). The profiles show that, while use of literacy skills and other knowledge-intensive activities is most prevalent in skilled information occupations, these activities pervade all occupational categories. Chapter 4 examines the apparent mismatch between educational qualifications of university graduates and knowledge content of occupations in which they work. IALS data show that university graduates with low levels of literacy skills are far more likely to experience job-education mismatch (work in industries that require less than a bachelors degree) than are other university graduates and that mismatch is associated with sizeable earnings loss for postsecondary graduates. The chapter suggests that the most probable explanation for the increased job-education mismatch for university graduates between 1981-91 is that the number of university graduates in the workforce increased more rapidly than the number of jobs in the skilled information group of occupations. Appendixes contain initial and final assignments of occupations, output of discriminant analysis, and 10 references. (YLB)

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Applied Research Branch
Strategic Policy
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Direction générale de la recherche appliquée
Politique stratégique
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Literacy Skills, the Knowledge Content of Occupations and Occupational Mismatch

W-99-3E

by
Daniel Boothby
August 1999

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Abstract

This paper examines several aspects of the knowledge content of work and its relationship with both workers' education level and their literacy skills. In the first part, occupations are classified into seven categories based on the knowledge content of the work. In the second part, profiles are developed of the prevalence in each occupational category of various types of work activities—in particular those involving the use of literacy skills. These profiles use data from the Canadian sample of the International Adult Literacy Survey (IALS). In general, the profiles show that, while use of literacy skills and other knowledge-intensive activities is most prevalent in skilled information occupations, these activities pervade all occupational categories.

In the third part, the issue of apparent mismatch between the educational qualifications of university graduates and the knowledge content of the occupations in which they work is examined. Data from the IALS show that university graduates with low levels of literacy skills are far more likely to experience job-education mismatch than are other university graduates. Mismatch is also associated with a sizeable earnings loss for post-secondary graduates, even when other factors affecting earnings are taken into account.

Census data show increased job-education mismatch for university graduates between 1981 and 1991. Several possible explanations for this increase are examined. The most probable explanation is that over this period, the number of university graduates in the workforce increased more rapidly than the number of jobs in the skilled information group of occupations.

Résumé

Le présent document examine plusieurs aspects des connaissances relatives au travail ainsi que leur rapport avec le niveau d'éducation et le degré d'alphabétisation des travailleurs. Dans la première partie, les professions sont classées selon sept catégories fondées sur les connaissances relatives au travail. La deuxième partie présente des profils de l'importance de divers types d'activités professionnelles - en particulier celles qui nécessitent de l'alphabétisation - dans chacune des catégories professionnelles. Pour ces profils, il y a eu recours aux données de l'échantillon canadien de l'Enquête internationale sur l'alphabétisation des adultes (EIAA). Dans l'ensemble, les profils montrent que ces activités se retrouvent dans toutes les catégories professionnelles, bien que les activités nécessitant de l'alphabétisation et celles nécessitant des connaissances approfondies se rattachent plus souvent à des professions nécessitant des qualifications.

La troisième partie traite du défaut de complémentarité qui existerait entre les qualifications des diplômés universitaires et les connaissances relatives aux professions qu'ils exercent. Les données de l'EIAA révèlent que les diplômés universitaires qui présentent un faible niveau d'alphabétisation sont beaucoup plus susceptibles que les autres de connaître un défaut de complémentarité entre leurs études et leur emploi. Ce défaut de complémentarité est aussi associé à une perte de revenu assez importante pour les diplômés d'établissements d'enseignement postsecondaire, même lorsqu'il est tenu compte d'autres facteurs influant sur le revenu.

Les données du recensement montrent l'existence d'un défaut de complémentarité accru entre les études et l'emploi des diplômés universitaires entre 1981 et 1991. Plusieurs explications possibles pour cette croissance sont examinées. L'explication la plus probable est que durant cette période, le nombre de diplômés universitaires participant dans le marché du travail a augmenté plus rapidement que le nombre d'emplois dans le groupe de professions nécessitant des qualifications.

Acknowledgements

This paper could not have been written without the assistance of Scott Murray, Nancy Darcovich and Richard Porzuczek of Statistics Canada who helped the author obtain access to the original Standard Occupational Classification codes on the International Adult Literacy Survey file. Ali Béjaoui generously provided his skill type scores and contributed in many other areas of this paper. Yves Gingras, Richard Roy, Marie Lavoie and Scott Murray provided useful comments on earlier drafts.

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1. Introduction

The "knowledge economy" has become a popular catch phrase and a subject of considerable interest for policy makers and the public. It is self-evident that workers have always needed knowledge of their work. Presumably what differentiates a "knowledge economy" is an increasing part of work which consists in manipulating symbolic objects, rather than things, and an increasing proportion of workers whose work requires a high degree of knowledge.

Understanding the knowledge economy thus requires analysis of the knowledge content of work and of how workers acquire the high-level knowledge they use in their work. This paper examines several aspects of the knowledge content of work and of the relation between the knowledge content of work and workers' educational level and literacy skills. The first two parts attempt to distinguish among jobs on the basis of their knowledge content and to differentiate among jobs with different levels of knowledge content on the basis of workers' activities in these jobs. The data used in the second part of the paper is drawn from the Canadian sample in the 1994 International Adult Literacy Survey (IALS).

The third part of the paper is an examination of the issue of mismatch between the educational qualifications of post-secondary graduates and the knowledge content of the occupations in which they work. Since post-secondary education is costly both for society and for individual students, job-education mismatch may indicate misallocation of individual and social resources.

Previous research in Canada using the IALS (Krahn and Lowe, 1998) has examined mismatch between levels of literacy skills and use of literacy skills at work. Research in the United States has examined the issue of mismatch in terms of a growing number of university graduates working in high school jobs. A recent contribution to this literature (Pryor and Schaffer, 1997) uses data from the 1992 National Adult Literacy Survey to show that university graduates working in high school jobs have lower literacy levels on average than other university graduates.

A multivariate model is used to examine the determinants of mismatch between post-secondary educational qualification and job category in Canada. The earnings consequences of mismatch in a multivariate earnings model are then analyzed. Both of these models use data from the Canadian IALS. Census data are used to show that job-education mismatch increased for

university graduates from 1981 to 1991. Possible causes for increased mismatch are then considered, using data from both the Census and the IALS.

The conclusion briefly summarizes the principal findings of the paper and points out their implications for the knowledge economy.

2. Development of Occupational Categories

This study is part of an ongoing research program into the knowledge economy carried out by the Applied Research Branch (ARB) of Human Resources Development Canada (HRDC). Two lines of recent research at the ARB have sought to describe occupations in terms of broad types of skills used in these occupations. Lavoie and Roy (1998) explored the sources of the growth of the relative importance of knowledge workers in the Canadian economy in terms of changes in the composition of final output, productivity shifts and intra-industry substitution between different types of workers. They divided Canadian occupations into groups based on the occupational groups used in earlier, similar work on US data by Wolff and Baumol (1989).

Lavoie and Roy's classification scheme first divides occupations into information occupations and non-information occupations. Non-information occupations are divided between goods occupations (in which workers are engaged in the production of goods) and service occupations (where workers are engaged in the production of services). Information occupations are divided among management occupations, knowledge occupations and data occupations. Management occupations are more or less self-explanatory. Knowledge occupations "involve mainly the generation of ideas or the provision of expert opinions." Data occupations "involve the manipulation of symbolic information" (Lavoie and Roy, 1998, p.11).

In other research at ARB, Béjaoui (forthcoming) has used data from the Canadian Classification and Dictionary of Occupations (CCDO) to develop measures of levels of five broad types of skills in the CCDO four-digit occupations. These five skill types are described as follows:

1) authority-management skills,
2) cognitive skills,
3) communication skills,
4) gross motor skills, and
5) fine motor skills.

One would obviously expect that management occupations would require high levels of authority–management skills, that knowledge occupations would require high levels of cognitive skills, and so on. The classification exercise described in this section is aimed at producing a classification system in which these expectations are realized.

2.1 Classification Method

The goals in developing an occupational classification structure were to group occupations based on the knowledge content of work in these occupations and to produce a grouping of occupations in which the distribution of the levels of Béjaoui's skill types among occupational categories is consistent with our expectations. The classification system is based on that used by Lavoie and Roy (1998). As described above, they divided occupations into five categories—management, knowledge, data, service and goods. Two of their occupational categories, the data category and the goods category were subdivided, because there is a useful distinction to be made within these two categories based on the knowledge content of work.

The term "data occupations" is reserved in this paper for information occupations in which a high degree of knowledge is applied, but which are not primarily involved in creating knowledge or supplying expert opinion. Occupations that require only the routine manipulation of symbolic information are called "data-manipulation occupations."

Similarly, goods occupations were divided into skilled goods occupations and other goods occupations. Skilled goods occupations require the application of a high degree of knowledge or acquired skills, while other goods occupations are of a more routine nature. Thus, there are seven occupational categories in place of Lavoie and Roy's five: management, knowledge, data, data manipulation, service, skilled goods, other goods. This system of classifying occupations is summarized in Table 1.

Table 1: Structure of Occupational Classification System

Broad Group	Group	Category	Example
Information	Skilled Information	Management	Production Manager
		Knowledge	Geologists
		Data	Registered Nurses
	Other Information	Data Manipulation	Secretaries and Stenographers
Service		Service	Bartenders
Goods		Skilled Goods	Tool and Die Makers
		Other Goods	Structural Metal Erectors

In Lavoie and Roy's classification framework, the group of data occupations is quite diverse, including groups such as various technologists and technicians on the one hand, and various clerks and sales clerks on the other hand. Technologists and technicians were assigned to the data

category and clerical occupations to the data-manipulation category. Even so the data category remains diverse and somewhat difficult to define precisely.

Once a typology of occupations was established, an initial distribution of the 4-digit occupations in the 1980 Standard Occupational Classification (SOC) among our seven categories was made. We then sought to establish whether this distribution of occupations was consistent with a grouping of occupations based on the scores assigned to these occupations for each of Béjaoui's five broad skill types. To do so, a discriminant analysis was performed using the occupational category as the classification variable and Béjaoui's five skill type scores as the variables of the discriminant function.[1]

The discriminant analysis suggested that 152 of the 500 SOC occupations were misclassified. In four of the seven occupational categories, over 80 percent of the initial assignments were correct. These four categories accounted for only 20 of the 152 "misassignments." The highest rate of "misassignment" occurred in the data category, where 34 of 70 occupations had a "most probable" category other than the data category. Of these, 17 had management and knowledge occupations as the most probable category and 13 had data manipulation or skilled goods occupations as the most probable category.

In the other goods category, 165 of 244 occupations were correctly assigned, while 60 occupations had skilled goods as the most probable category and 13 had service occupations as the most probable category. In the service category, 24 of 43 occupations were correctly assigned and 8 had other goods as the most probable category.

After carrying out the initial discriminant analysis, each occupation, which was misassigned according to this analysis was examined. The occupation was either reassigned or not, depending on the appropriateness of the proposed reassignment in light of the conceptual framework and of the description of the occupation in the SOC and the CCDO.

[1] Discriminant analysis constructs a measure of distance to each classification group (the occupational categories) for each of the objects to be classed (occupations), based on the observed features of each object (the five scores). It then identifies the most probable group for each object as the "closest" group according to this distance measure. The discriminant analysis described here was carried out using PROC DISCRIM in SAS, with the nopool option.

All of the 60 suggested reassignments from other goods occupations to skilled goods occupations were accepted, as were the two reassignments from skilled goods to other goods. An additional 28 occupations were also reassigned to the category suggested by the discriminant analysis. A further seven occupations were reassigned to the second most probable category according to the discriminant analysis. One occupation was reassigned to a category other than the two most probable categories. The remaining 54 reassignments suggested by the discriminant analysis were rejected. Finally, for the sake of consistency with reassignments of related occupations, one occupation for which the discriminant analysis suggested the initial assignment was correct was reassigned.

Another round of discriminant analysis was performed and 12 occupations that had not been suggested for reassignment in the first round were reassigned. The reclassification process was stopped at this point. A final round of discriminant analysis showed that the classification error rates had improved for every class, relative to the first round of discriminant analysis. Overall, 56 occupations were "misassigned" according to the final discriminant analysis, compared to 152 occupations in the first round.

The two highest rates of "misassignment" were in data occupations (31 percent) and service occupations (28 percent). These were also the categories in which the largest number of suggested reassignments were rejected. All other categories except knowledge occupations had a "misassignment" rate of less than 10 percent. In the knowledge category, "misassignment" of one occupation resulted in a "misassignment" rate of 11 percent.

The results of this process are summarized in Table 2. For each occupational category, the table shows the number of occupations in the category and the error rate according to the discriminant analysis at the beginning and at the end of the classification process. The initial and final classifications of 4-digit SOC occupations and the results of the discriminant analyses are given in Appendix A.

Two points need to be made about the classification process. First, the discriminant analysis was used essentially as a tool to point out possible misclassifications. The decision as to where to classify each occupation was ultimately based on the author's judgement. Second, the scores used in the discriminant analysis are based on the attributes of occupations as described in the CCDO, an occupational dictionary that dates from the 1970s. Any changes in the attributes of

occupations since this time will not have been captured by these scores, and will not be reflected in the discriminant analysis. Ultimately, this may have lead to misclassification of some occupations in which skill levels have risen or fallen.

Table 2: Summary of the Occupational Classification Process

Occupational	Initial Classification		Final Classification	
	Number	Percent Error	Number	Percent Error
Management	20	10.0	23	4.4
Knowledge	41	12.2	37	10.8
Data	70	48.6	67	31.3
Data Manipulation	49	16.3	44	4.6
Service	43	44.2	50	28.0
Skilled Goods	33	15.2	89	6.7
Other Goods	244	32.4	190	4.2
Total	500	30.4	500	11.2

2.2 Levels of Skill Types in Occupational Categories

As stated above, the goals of this classification exercise were to arrive at a system of occupational categories. These categories are consistent with the aim of grouping occupations on the basis of the type of work performed, in particular, on the knowledge content of work, and which have a distribution of levels of the five skill types described in Béjaoui's work that is consistent with our expectations. Specifically, these expectations are as follows:

1) Management occupations will have the highest levels of the authority-management skill type.
2) Knowledge occupations will have the highest levels of the cognitive skill type, followed by data and management occupations.
3) Management occupations will have high levels of the communications skill type.
4) Skilled goods occupations will have higher levels than other goods occupations of the cognitive and motor skill types.

The different occupational categories certainly should differ in their levels of the skill type scores, since the scoring system based on the five skill types was quite successful in differentiating among occupations in the different categories in the discriminant analysis. Figures 1a through 1e seek to confirm that the various categories not only differ in terms of these skill types, but also meet the expectations as to which categories should have higher or lower levels of

the various skill types. The figures give the average scores over all occupations in each occupational category for each of Béjaoui's five skill types.[2]

Figure 1a shows the average level of the authority/management skill type in the occupational categories. As expected, management occupations have the highest level of this skill type, followed by knowledge occupations. Somewhat lower levels of this skill type are found in data and skilled goods occupations. The presence of relatively important authority/management skills in knowledge, data and skilled goods occupations presumably reflects the fact that these occupations may involve considerable supervisory responsibilities. Again as expected, data manipulation, service and other goods occupations have the lowest levels of this skill type.

Figure 1a. Authority/Management Skill Type: Average Level by Occupational Category

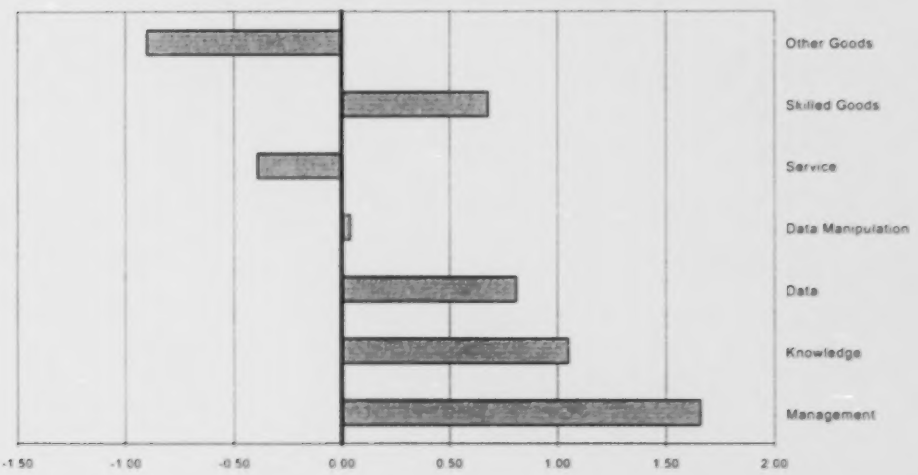


Figure 1b shows the average levels of the cognitive skill type. As expected, the highest levels are found in knowledge occupations, followed by management occupations and data occupations in that order. In skilled goods occupations there are considerably lower levels of this skill type, which are nonetheless much higher than the levels in data manipulation occupations, service occupations and other goods occupations.

[2] Béjaoui established the five scores using a Lisrel factor analysis in which one variable had its coefficient fixed at 1 for each skill type. The scaling for each score is in multiples of the assigned level of 1 for this fixed-score factor. See Béjaoui (forthcoming) for details. Since the scores are normalized to zero and have an arbitrary scale, the level of the score has no intrinsic meaning. It is the relative scores for the categories which should be compared; not the absolute scores.

Figure 1c gives the average levels of the communication skill type in each occupational category. Management occupations have by far the highest level of this skill type. Knowledge and data occupations are next, followed by data manipulation and skilled goods occupations. The lowest levels of this skill type are in service occupations and other goods occupations.

Figure 1b. Cognitive Skill Type:
Average Level by Occupational Category

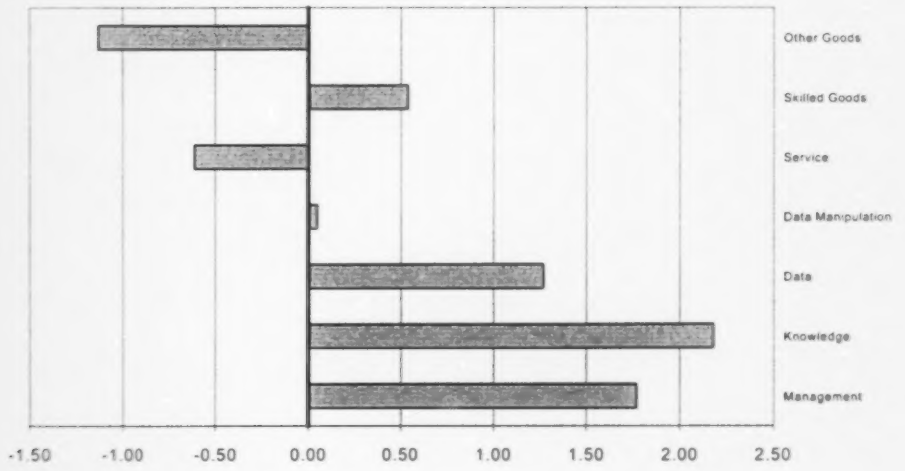
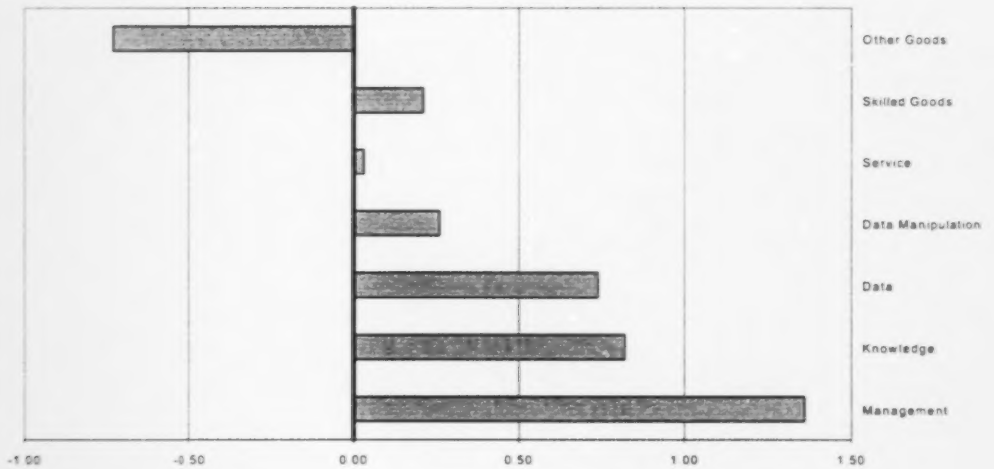


Figure 1c. Communication Skill Type:
Average Level by Occupational Category



As shown in Figure 1d, knowledge occupations have by far the highest levels of the fine motor skill type, followed by data occupations. This result is surprising at first glance. It presumably reflects a requirement for fine manipulations in many professional and technical occupations, for example in health professions and in various technologist and technician occupations. The lowest levels of this skill type are found in management, service and data manipulation occupations; the skilled goods and other goods occupations are in the middle position.

Figure 1d. Fine Motor Skill Type:
Average Level by Occupational Category

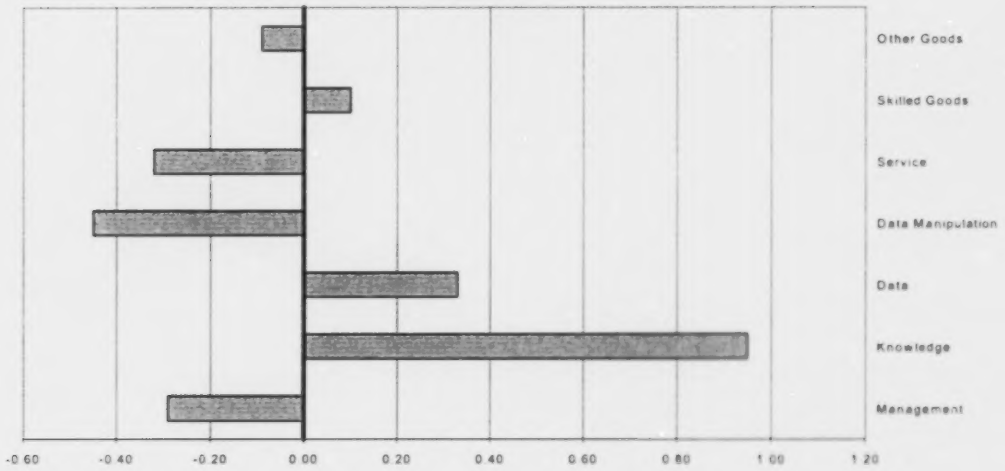
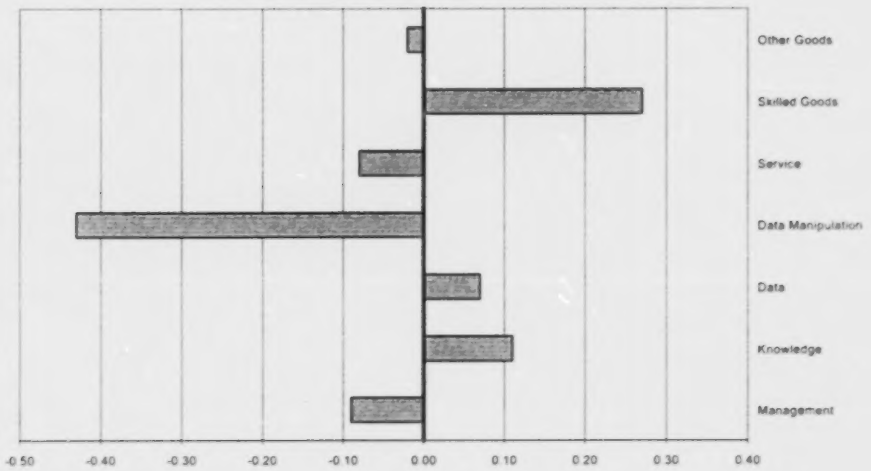


Figure 1e shows average levels of the gross motor skills type. The highest levels of this skill type are found in skilled goods occupations.[3] The lowest levels are found in the data manipulation occupations. All of the other occupational categories are in a middle range.

[3] In the author's view, the terms "fine motor skills" and "gross motor skills" are misleading. Examination of the contributions of various qualifications to each of these skills (Béjaoui, forthcoming) leads us to think that "fine motor skills" might more appropriately be called "laboratory skills" and "gross motor skills" "craft skills." This paper uses Béjaoui's terms for these skill types, however.

Figure 1e. Gross Motor Skill Type:
Average Level by Occupational Category



To sum up, management occupations are characterized by the highest level of authority/management skills and of communication skills, and by a level of cognitive skills second only to knowledge workers. They require low levels of motor skills.

Knowledge occupations have the highest level of cognitive skills, and have authority-management and communication skills second only to management occupations. Data occupations have the third-highest levels of cognitive skills, of authority/management skills and of communication skills. Knowledge and data occupations differ from management occupations by requiring high levels of fine motor skills. By far the highest levels of these skills are required in knowledge occupations; data occupations have the second-highest level of these skills.

Skilled goods occupations have the fourth-highest levels of authority/management skills and of cognitive skills. They are most clearly distinguished from other occupational categories by having by far the highest required levels of gross motor skills. Knowledge and data workers have the second and third-highest level of gross motor skills and the highest and second-highest level of fine motor skills; skilled goods occupations have the third-highest level of fine motor skills.

Data manipulation occupations and service occupations follow the management, knowledge, data and skilled goods categories in levels of authority/management skills and of cognitive skills. These two groups have the lowest levels of fine and gross motor skills. Data manipulation occupations have slightly higher levels of communication skills than skilled goods occupations.

Other goods occupations have the lowest levels of authority/management, cognitive and communication skills. They rank ahead of data manipulation and service occupations in fine and gross motor skills.

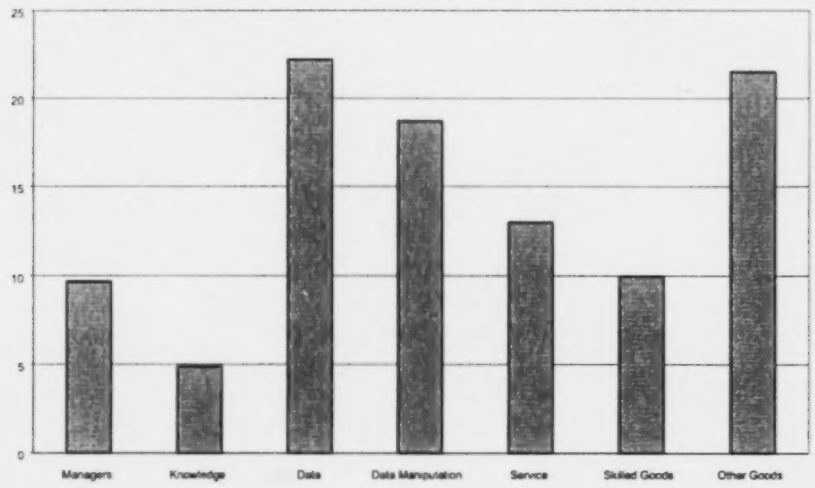
In general, the levels of the skill types in the occupational categories are consistent with the expectations given above. The results which appear the most surprising are the high levels of authority-management skills in knowledge occupations (and to a lesser extent in data occupations) and the high level of fine motor skills in knowledge occupations (and again in data occupations). Many knowledge and data occupations, for example in the health field, require considerable manipulation skills, however. Knowledge occupations have considerable supervisory content in their work, perhaps explaining the high level of the authority-management skill type in these occupations.

3. The Knowledge Content of Work–Profiles Using the IALS

This section examines the knowledge content of work in each of the seven occupational categories using data from the 1994 Canadian sample of the IALS. The IALS is an especially rich data source for this purpose because of the information it gives on work activities, literacy and numeracy skills and job-related training. Thanks to the collaboration of Statistics Canada personnel, it was possible to recode the original 4-digit SOC codes for the major job on the IALS master files into the seven occupational categories.

Figure 2 gives the distribution of major jobs of non-students in the IALS among the seven occupational categories. The knowledge category is the smallest group with around 5 percent of all jobs, the managerial category the next smallest with around 10 percent of employment. The data category is the largest with 22 percent of employment, while the data manipulation category covers 19 percent of employment. Overall, the information occupational categories (management, knowledge, data, data manipulation) account for 56 percent of employment, while the skilled information categories (management, knowledge and data) comprise 37 percent of employment.

Figure 2. Percentage Distribution of Employment by Occupational Category



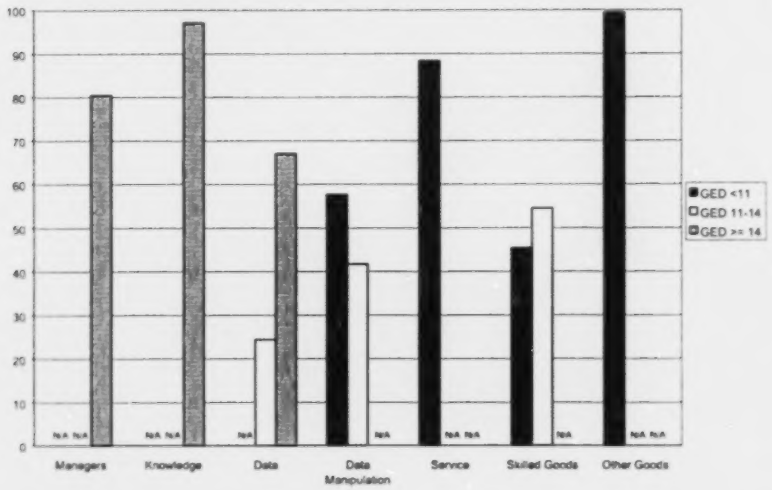
Next to data manipulation, the largest occupational category is other goods workers, with 21 percent of employment. Skilled goods workers are 10 percent of employment, so that the two

categories of goods workers make up 31 percent of employment. Service workers constitute the remaining 13 percent of employment. [4]

3.1 GED Levels and Literacy Skills

One widely used way to characterize the knowledge content of an individual's work is by the educational requirements of the occupation in which the person is employed. In Figure 3, the average GED (General Educational Development) level by occupational category for employed persons in our sample is given. GED levels have been translated into approximate years of schooling in the figure.[5]

Figure 3. Distribution of GED Level of Employment by Occupational Category



Almost all knowledge workers are in occupations in our highest GED group, while almost all other goods workers are in occupations in the lowest level. Around 80 percent of persons working in management occupations are in jobs at the highest GED level, while slightly less than 70 percent of data workers are at the highest GED level. Over 50 percent of skilled goods workers

[4] This distribution is similar to the one obtained from 1991 Census data for persons 25-54 years old with paid employment—management 10.5 percent, knowledge 6.2 percent, data 17.7 percent, data manipulation 24.2 percent, service 7 percent, skilled goods 8.8 percent, other goods 20.0 percent.

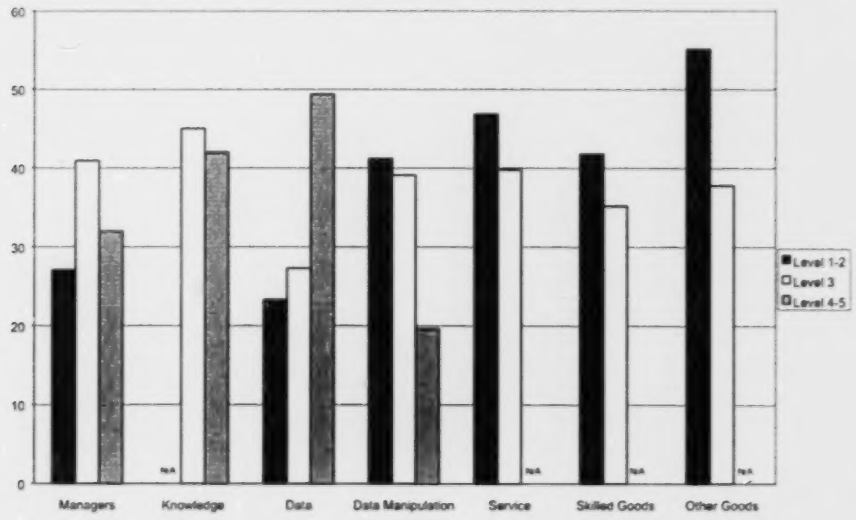
[5] In Figure 3, as in many of the other figures drawn from the IALS, certain categories are omitted due to insufficient sample size. General Educational Development (GED) is the measure of the educational requirements of an occupation used in the Canadian Classification and Dictionary of Occupations. The GED levels for 4-digit SOC occupations used here were developed by Wayne Roth, Applied Research Branch, Human Resources Development Canada.

are at the intermediate GED level, while around 45 percent are at the lowest GED level. Nearly 60 percent of data manipulation workers and nearly 90 percent of service workers are in jobs at the lowest GED level.

Before turning to an examination of the content of work using the IALS, the literacy skills of persons in our occupational categories will be examined. The IALS measured three types of literacy skills: prose literacy, document literacy and quantitative literacy. Summarizing roughly, prose literacy is the ability to understand and use information contained in a variety of documents. Document literacy is the ability to process information in a variety of documents (for example, schedules, charts, graphs, maps, tables, maps and forms) by locating, cycling, integrating and generating information. Quantitative literacy is the ability to locate the required information in documents, then set up and carry out the computations required to use this information (OECD, 1997, Annex A).

Figure 4a shows the distribution of prose literacy levels among the occupational categories; Figure 4b shows the distribution of document literacy levels; Figure 4c shows the distribution of quantitative literacy levels. Level 4-5 is the highest level of skill, level 1-2 is the lowest.

Figure 4a. Prose Literacy Levels by Occupational Category



These figures show a striking difference in the concentration of high levels of literacy skills between the knowledge and data categories and the other occupational categories. Over 40 percent of knowledge and data workers are at skill level 4-5 for each type of literacy, while no

other occupational category has as much as 40 percent at skill level 4-5 for any literacy type. Nearly 40 percent of managers are at skill level 4-5 for document literacy and quantitative literacy, while over 20 percent of data manipulation workers are at this skill level for each literacy type. On the other hand, skill level 1-2 is the largest group for data manipulation workers for each literacy type. This is also the case for service workers, skilled goods workers and other goods workers.

Figure 4b. Document Literacy Levels by Occupational Category

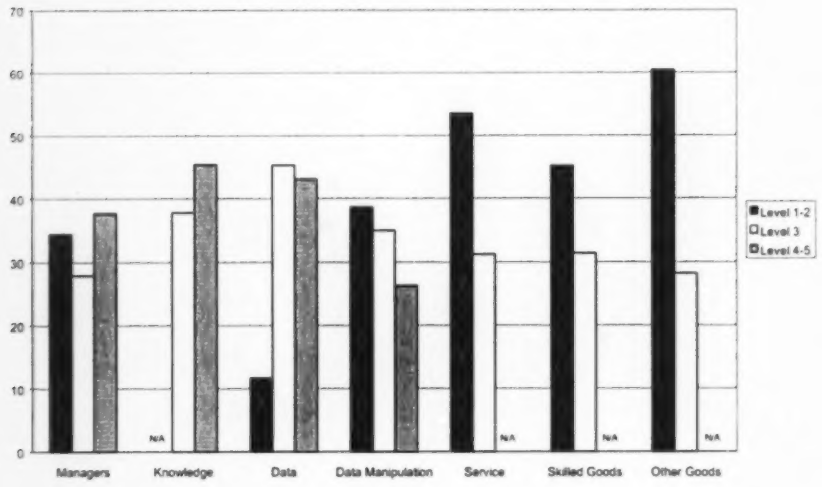
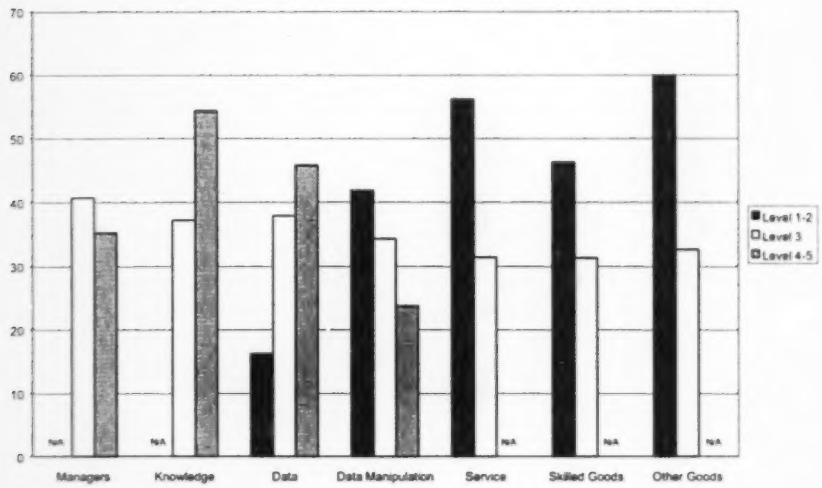


Figure 4c. Quantitative Literacy Levels by Occupational Category



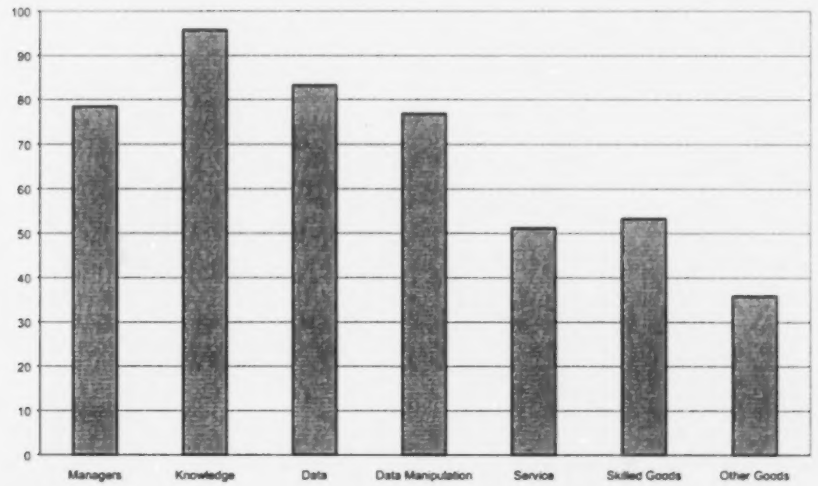
3.2 Reading Activities

The IALS contained a series of questions about various types of work activities involving reading, writing and the use of quantitative skills. The next groups of figures describe the prevalence of these activities among workers in our occupational categories. The IALS items concerning these activities asked respondents whether they performed the activity at work "every day," "a few times a week," "once a week," "less than once a week," or "never." The percentage of respondents who had worked who reported performing the activity more than once a week, that is, "every day" or "a few times a week" is given.

This is an approximate measure of the character of work activities, since it is not very precise as to the frequency with which the activity in question is performed and tells us nothing about the daily or weekly time spent in the activity or its importance among the respondent's work activities. Nonetheless, there are striking differences among the occupational categories in the prevalence of the activities considered using this measure.

The first group of figures concerns reading activities. Figure 5a gives the percentage of workers in each occupational category that reported reading letters or memos more than once a week for their job. Over 95 percent of knowledge workers report this activity, as do over 80 percent of data workers and almost 80 percent of managers and of data manipulation workers. Over 50 percent of skilled goods workers and of service workers report this activity. Other goods workers

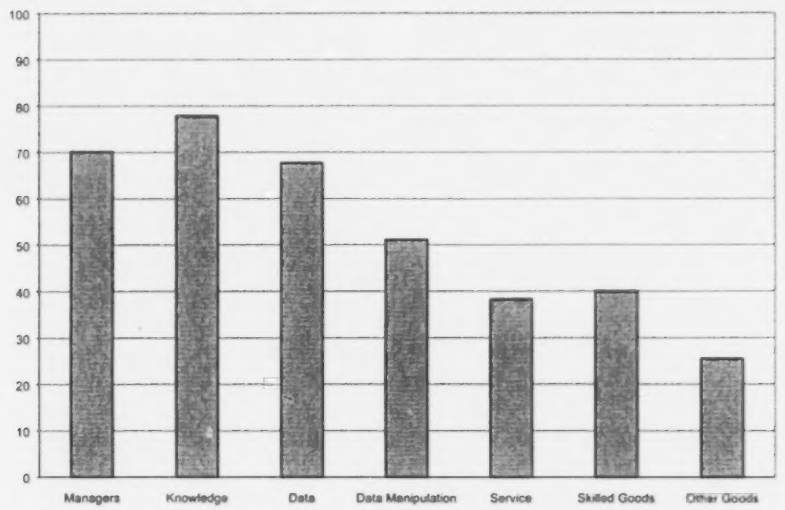
Figure 5a. Percentage Who Read Letters or Memos More Than Once a Week



are the only occupational category where less than half of all workers (about 35 percent) read letters and memos more than once a week for their job.

Figure 5b gives the percentage of workers in each occupational category that read reports or articles more than once a week for their job; Figure 5c gives the percentage that read manuals or reference books more than once a week for their jobs. In each of Figures 5a, 5b and 5c, the highest percentage of workers who report the activity is in the knowledge category, followed by managers and data workers, followed by data manipulation workers, skilled goods workers, service workers and other goods workers.

Figure 5b. Percentage Who Read Reports or Articles More Than Once a Week



The percentage who report the activity is lower in every occupational category for reading reports or articles (Figure 5b) than for reading letters or memos (Figure 5a) and for reading manuals or reference books (Figure 5c) than for reading reports or articles. Managers are considerably more likely than data workers to read manuals or reference books; the two groups have very similar levels of reading letters or memos and of reading reports or articles. Similarly, skilled goods workers are considerably more likely than service workers to read manuals or reference books, but the two groups have similar levels for reading letters or memos and for reading reports or articles.

Figure 5c. Percentage Who Read Manuals or Reference Books More Than Once a Week

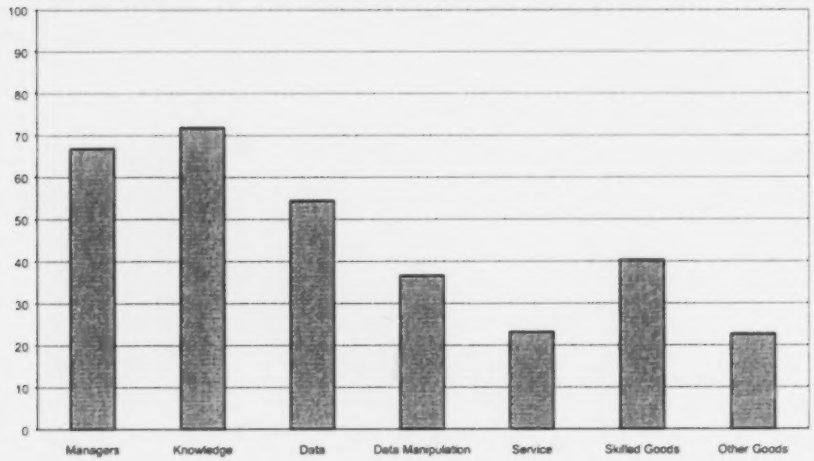
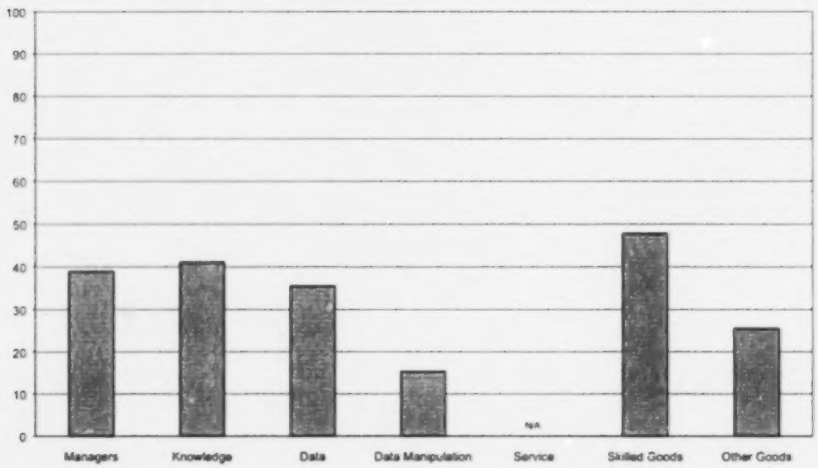


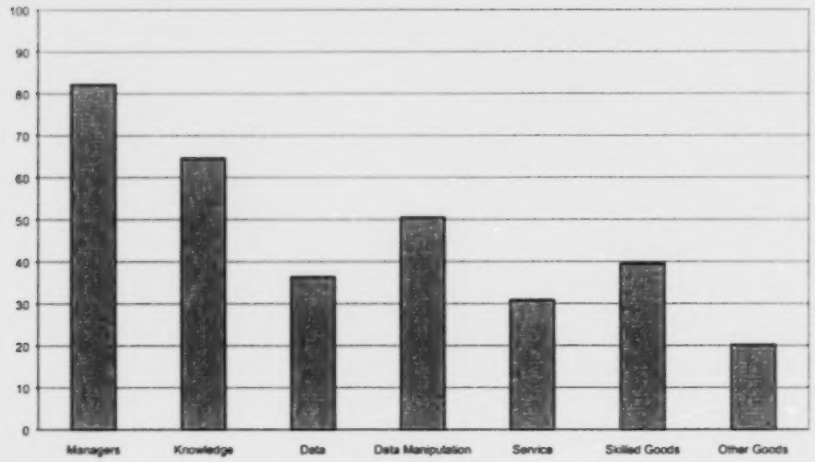
Figure 5d shows the percentage of workers in the occupational categories who read diagrams or schematics more than once a week. Figure 5e shows the percentage that read bills or spreadsheets more than once a week. The response patterns in these two figures are very different from the patterns in three preceding figures on reading activities. Skilled goods workers is the occupational category with the highest percentage reporting that they read diagrams or schematics more than once a week for work (almost 50 percent). Almost 40 percent of managers report this activity, followed by data workers, other goods workers and data manipulation workers.

Figure 5d. Percentage Who Read Diagrams or Schematics More Than Once a Week



In Figure 5e, managers have the highest percentage reporting that they read bills or spreadsheets more than once a week, followed by knowledge workers. A higher percentage of data manipulation workers and a slightly higher percentage of skilled goods workers than of data workers report this activity. About 30 percent of service workers and about 20 percent of other goods workers report reading bills or spreadsheets more than once a week.

Figure 5e. Percentage Who Read Bills or Spreadsheets More Than Once a Week



3.3 Writing Activities and Use of Quantitative Skills

The next four figures concern writing at work. Figure 6a shows the percentage of workers in each occupational category who write letters and memos more than once a week for their work. Almost 80 percent of knowledge workers and around 75 percent of managers report this activity, as do about 60 percent of data manipulation workers and 50 percent of data workers. About 30 percent of skilled goods workers and of service workers write letters or memos, while only about 20 percent of other goods workers do so.

Figure 6b shows the prevalence of writing reports or articles more than once a week for our occupational categories. About 65 percent of knowledge workers report this activity, far more than in any other occupational category. About 45 percent of workers in the data category and slightly less than 40 percent of managers write reports or articles more than once a week. Around 30 percent of data manipulation workers and of skilled goods workers report this activity, as do about 20 percent of service workers and of other goods workers.

Figure 6a. Percentage Who Write Letters or Memos
More Than Once a Week

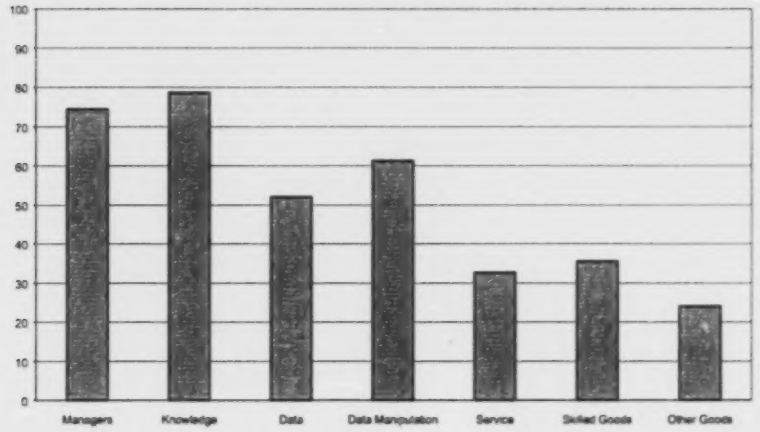
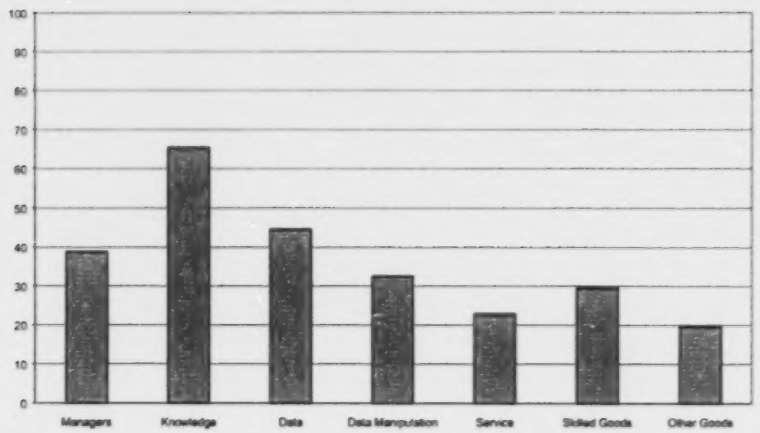


Figure 6b. Percentage Who Write Reports or Articles
More Than Once a Week



Knowledge workers are also the most likely to write estimates or specifications more than once a week, as shown in Figure 6c. Over 50 percent of knowledge workers report this activity, as do over 30 percent of managers and of skilled goods workers. About 25 percent of data workers write estimates or specifications; this drops to around 15 percent for data manipulation workers and for other goods workers.

Figure 6c. Percentage Who Write Estimates or Specifications More Than Once a Week

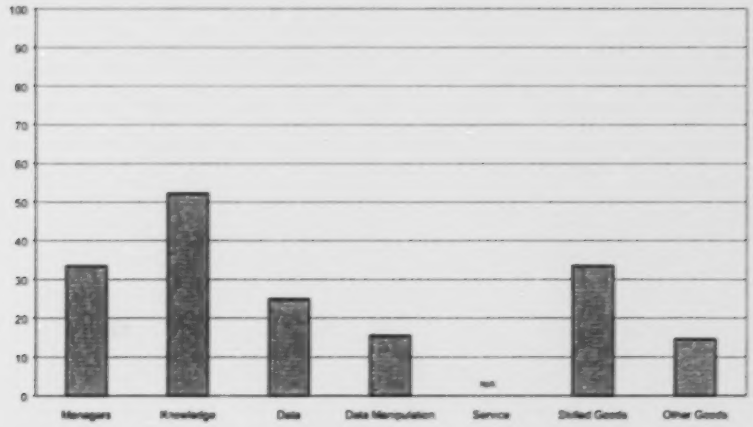


Figure 6d shows that the response pattern for writing bills and invoices is very different from the pattern for other writing activities, which are most frequent among knowledge workers. Almost 70 percent of managers write bills or invoices more than once a week, as do 60 percent of data manipulation workers. Between 30 percent and 40 percent of service workers and skilled goods workers report this activity, as do between 20 percent and 30 percent of other goods workers and data workers.

Figure 6d. Percentage Who Write Bills or Invoices More Than Once a Week

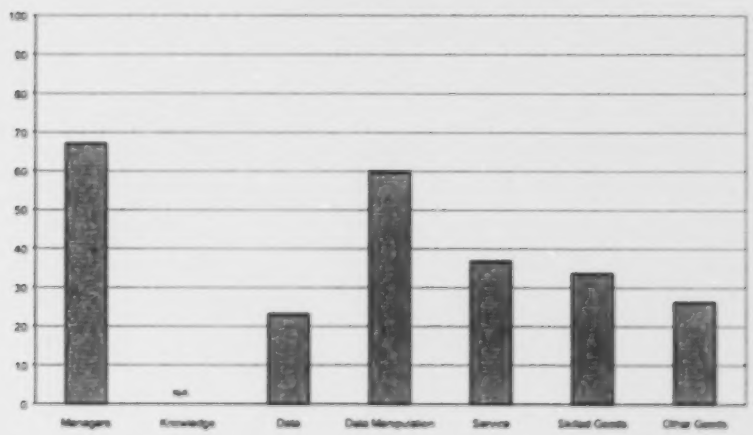
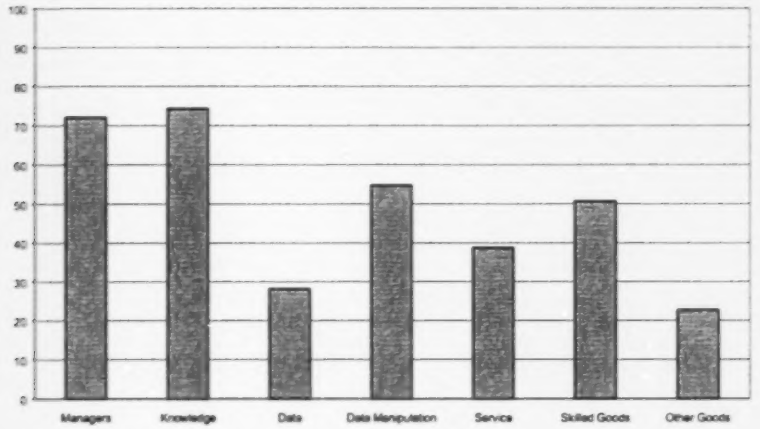


Figure 7 reports on the use of quantitative skills at work. The figure shows that over 70 percent of knowledge workers and of managers use math to calculate prices, costs or budgets more than once a week at work. Over 50 percent of data manipulation workers and of skilled goods workers

report this activity, as do around 40 percent of service workers, 30 percent of data workers and 20 percent of other goods workers.

Figure 7. Percentage Who Use Math to Calculate Prices, Costs or Budgets



3.4 Supervisory Responsibilities and Training

Supervising other workers is also an important work activity. Figure 8 shows the percentage of workers in each occupational category that report supervising other workers in the IALS. Not surprisingly, this activity is most prevalent among managers, 80 percent of who report that they supervise others. About 60 percent of knowledge workers and over 45 percent of skilled goods workers supervise other workers. Between 25 percent and 30 percent of data workers, service workers and data manipulation workers report they supervise others, as do 20 percent of other goods workers.

In the context of a knowledge economy, much emphasis is placed on job-related training aimed at upgrading workers' skills. Figure 9 shows the percentage of workers in each occupational category who had taken job-related training in the year preceding the IALS. Over 60 percent of knowledge workers and over 50 percent of data workers took job-related training. While it is not unexpected to find a high training intensity in these knowledge-based occupations, the low percentage of managers (around 35 percent) who took job-related training is more surprising. The percentage of managers who took training is lower than the percentage of data manipulation workers and only slightly higher than the percentage of service workers. Almost 30 percent of skilled goods workers took job-related training, as did over 20 percent of other goods workers.

Figure 8. Percentage Who Supervise Others

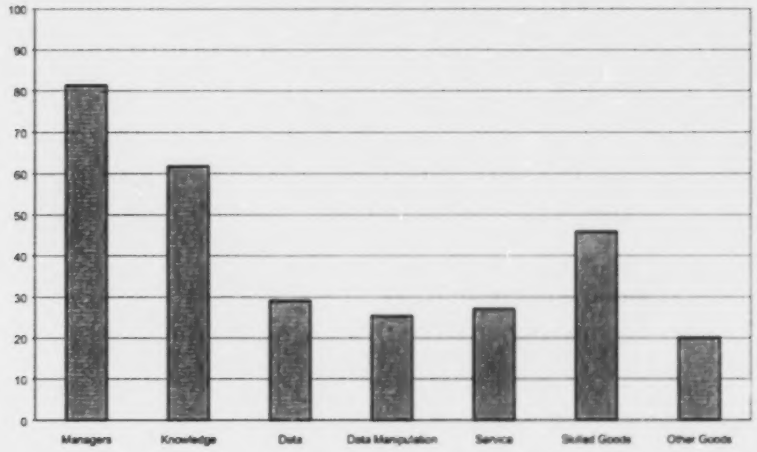
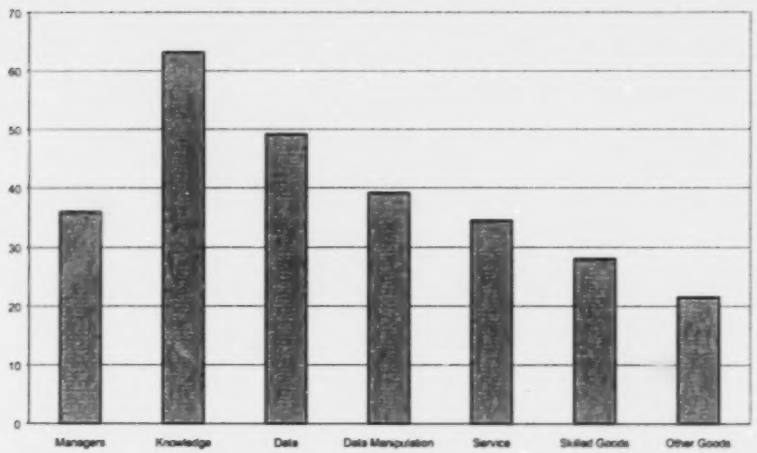


Figure 9. Percentage Who Took Job-Related Training in Last Year



3.5 Summary: The Knowledge Content of Work

This ends the profile of the content of work in the occupational categories using data from the Canadian sample of the IALS. In general, knowledge workers, data workers and managers make the most use of reading and writing at work. Workers in every occupational category use reading and writing at work, however, and the relative prevalence of specific activities among occupational categories varies with the type of activity. One reading activity—reading diagrams and schematics—is more prevalent among skilled goods workers than in any other occupational category.

Supervisory responsibilities are most common in the management occupational category, but are an important component of knowledge work as well. Many data and skilled goods workers also supervise other workers. Job-related training is by far most common among knowledge workers, followed by data workers. In all occupational categories, however, a significant proportion of the work force receives job-related training.

The relative distribution of knowledge-related activities among our occupational categories is much as we would expect. What is more surprising is the pervasive character of knowledge-related activities. Workers in all occupational categories make frequent use of literacy skills. Knowledge, data and skilled craft workers have important supervisory responsibilities. The widespread use of these knowledge-related skills in all occupational categories provides content for the slogan of a "knowledge-based economy."

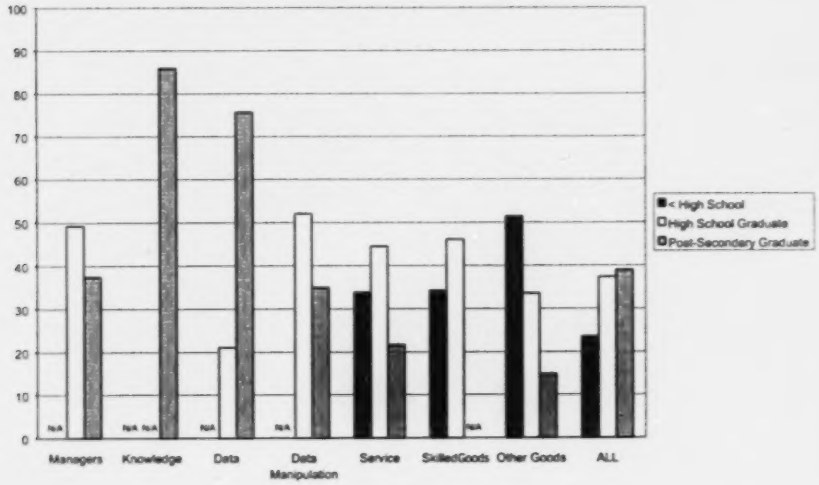
4. The Match Between Education and Occupation

This section concentrates on skilled information occupations, that is, occupations in the management, knowledge and data categories. The section examines how workers are matched to jobs in skilled information occupations, why some workers with a post-secondary occupation do not work in skilled information occupations, and what the consequences are for these workers in terms of their earnings. Job-education mismatch is shown to have increased for university graduates from 1981 to 1991. Possible reasons for this increase are considered.

It was shown above that workers in skilled information occupations (management, knowledge and data occupations) have high levels of literacy skills. Given the highly specialized nature of knowledge and data occupations, it is not plausible that high levels of literacy skills alone are a sufficient qualification for entry. These occupations are likely to require the acquisition of highly specialized skills through post-secondary schooling. Management occupations may have a higher component of skills acquired through work experience than knowledge and data occupations, and thus require lower schooling levels on average.

Figure 10 shows the educational distribution of workers in each occupational category. It confirms that workers in knowledge and data occupations are far more likely to have a post-secondary qualification than workers in management occupations. Over 85 percent of knowledge workers and over 75 percent of data workers have completed a post-secondary program. Less than 40 percent of managerial workers have completed a post-secondary program, about the same percentage as for the overall workforce. About 35 percent of data manipulation workers have completed a post-secondary program. Outside of the information occupational categories, there is no occupational category where as much as 25 percent of workers have completed a post-secondary program.

Figure 10. Educational Level by Occupational Category



4.1 Educational Qualifications and Occupational Category

Another way of looking at the relationship between educational qualifications and occupational category is by examining the occupations in which persons with various levels of educational qualification work. Post-secondary education is a costly process of skill acquisition. Do persons who invest in post-secondary education work in the skilled information sector of the work force? Is this sector readily accessible to persons without a post-secondary education? Figures 11a to figure 11d examine the relationship between educational attainment and the occupational category of employment.

Figure 11a shows that over 15 percent of university graduates work as knowledge workers and another 55 percent of university graduates work as data workers. More than 80 percent of university graduates work in skilled information occupations (management, knowledge and data). Over 90 percent of university graduates work in information occupations, which include data manipulation occupations as well as the skilled information occupations.

Figure 11a. Distribution of Employed University Graduates by Occupational Category (Selected Categories)

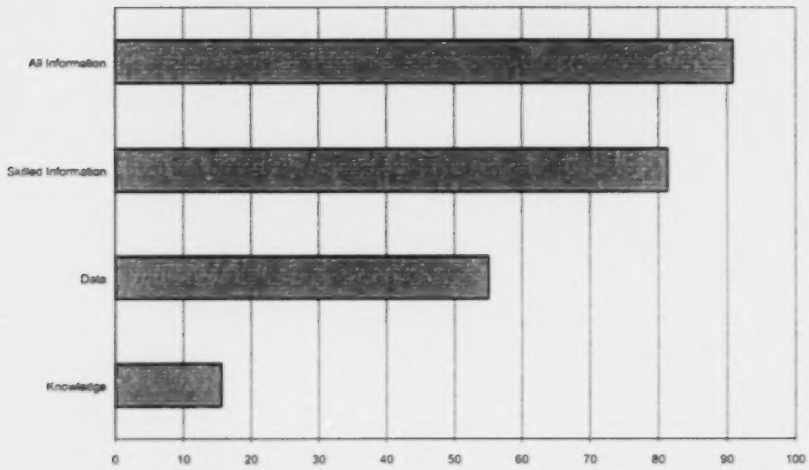


Figure 11b shows a similar picture for all post-secondary graduates (including university graduates). About 10 percent of this broader group work as managers, about 10 percent work as knowledge workers, and over 40 percent work as data workers, so that over 60 percent of this broader group are skilled information workers. Over 80 percent of post-secondary graduates work in information occupations. Post-secondary graduates, especially university graduates, are thus heavily concentrated in the skilled information sector.

Figure 11b. Distribution of Employed Post-Secondary Graduates by Occupational Category (Selected Categories)

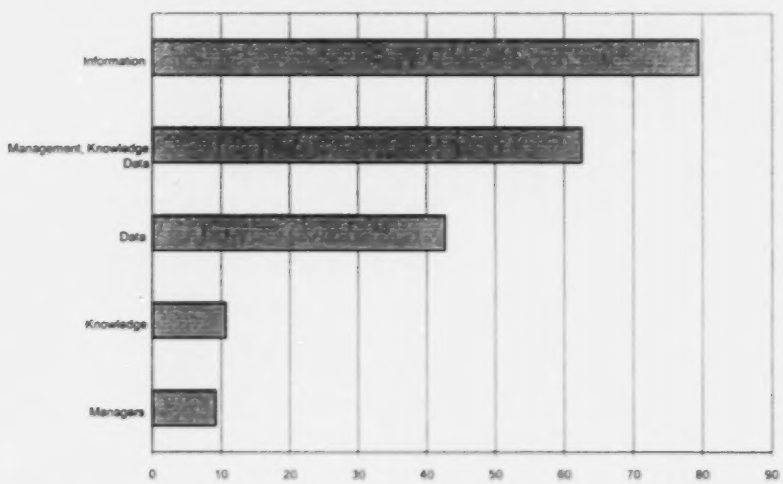


Figure 11c shows the occupational distribution of high school graduates. Almost 50 percent of high school graduates work in the goods and services occupational categories. More than 25 percent of them work in occupations in the data manipulation category. About 12 percent work in managerial occupations and 12 percent in data occupations. A negligible number work in knowledge occupations. Thus knowledge occupations are not accessible to persons with only a high school diploma, and the percentages of high school graduates working in managerial and data occupations are much lower than the percentages of persons with a post-secondary qualification working in these occupational categories.

Figure 11c. Distribution of Employed High School Graduates by Occupational Category

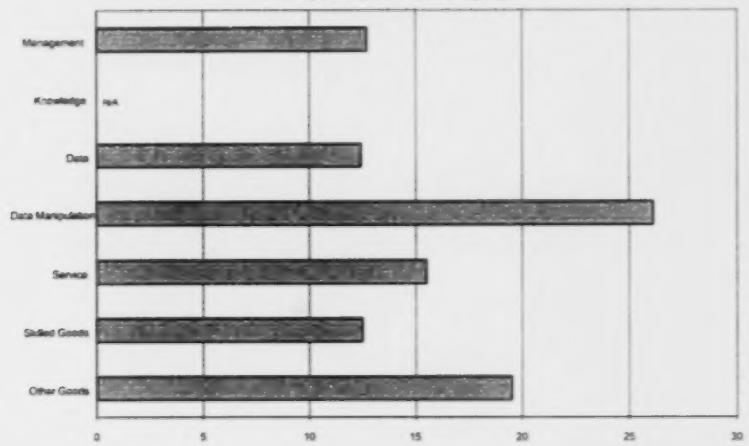
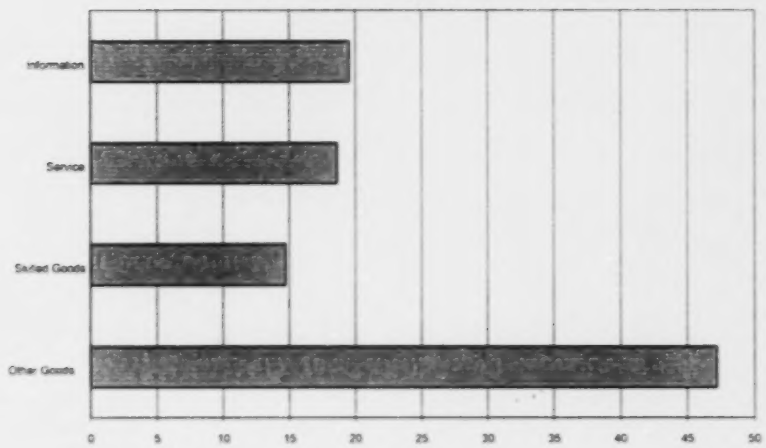


Figure 11d. Distribution of Employed Less Than High School Graduates by Occupational Category (Selected Categories)



The occupational distribution of persons with less than a high school education is given in Figure 11d. Almost 50 percent of these persons work in other goods occupations. Over 80 percent work in the goods and services sector of the workforce. Even the lower levels of the information sector of the workforce are difficult to access for this group of workers.

Are high literacy skills a sufficient qualification for skilled information occupations? Despite the fact that a significant proportion of high school graduates have strong literacy skills (see Figure 16 below), there are essentially no high school graduates in knowledge occupations and quite low proportions of high school graduates in data and management occupations.

This seems to indicate that workers in knowledge occupations need specific skills acquired during post-secondary schooling in addition to the high levels of literacy skills knowledge workers possess. This may also be true to a lesser degree for management and data occupations. In some cases, it may be possible to obtain the skills required by jobs in these latter categories through work experience. In addition, the strong component of the "communications" skill type in management occupations suggests that these occupations may require skills which are not always obtained through schooling.

4.2 Mismatch of Post-Secondary Education and Occupation

While most university graduates work in the skilled information sector, about 20 percent do not. This raises the question of why these individuals are working in occupations that do not appear to be appropriate to their educational level. This question has been the subject of considerable research interest in the United States, where it has tended to be phrased in terms of a growing proportion of university graduates who work in "high school jobs" (see for example, Hecker, 1992 and Tyler *et al*, 1995).

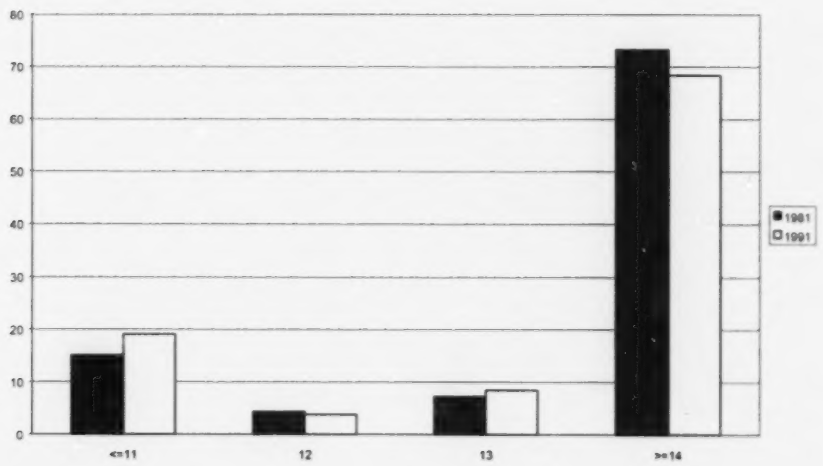
One possible explanation for university graduates in "high school jobs" is that there is an oversupply of university graduates. Tyler *et al* (1995) argue that this explanation is difficult to reconcile with the increasing salaries of university graduates relative to high school graduates. It might nonetheless be true for Canada, where the supply of university graduates has grown more strongly in recent years than in the US and where the relative wage of university graduates has been stable (See Murphy *et al.*, 1997, p.3 and Figure 1.).

Another explanation advanced for the U.S. by Pryor and Schaffer (1997) is that university graduates in high school jobs are in these jobs because they have high school skill levels. These authors used data from the U.S. panel of the IALS to show that university graduates in high school occupations have lower levels of literacy achievement on average than those in university-level occupations. They present data showing that the rise in the relative wages of university graduates is confined to university graduates in university-level occupations.

The U.S. literature thus raises three questions for Canada. First, is there a growing proportion of university graduates in Canada who work in jobs that do not require this level of education? Second, do university graduates in Canada who work in non-university level jobs have lower levels of literacy skills? Third, what are the earnings consequences for post-secondary graduates of working in occupations which do not require post-secondary schooling?

In response to the first question, Figure 12a shows a fall from 1981 to 1991 in the proportion of university graduates in paid employment working in jobs with a GED level equivalent to 14 or more years of schooling. Nonetheless, in both years over 75 percent of university graduates 25-54 years old worked in jobs requiring at least 13 years of schooling.[6]

Figure 12a. University Graduates by GED Level of Employment: Age 25-54



[6] Figures 29-31 are based on tables from the Census of Canada, which exclude residents of the territories and full-time students from their universe. These tables report levels of paid employment, so that the self-employed are excluded. Finally, temporary residents were excluded for 1991, to ensure comparability with 1981.

Figures 12b and 12c show that the drop in the GED levels of workers' jobs is not confined to university graduates. Among post-secondary, non-university graduates there is a rise from 1981 to 1991 in the proportion working in jobs which require less than 12 years of schooling (Figure 12b). Figure 12c shows that the proportion of high school graduates working in jobs that require less than 12 years of schooling also rose slightly from 1981 to 1991.

Figure 12b. Post-Secondary Non-University Graduates by GED Level of Employment: Age 25-54

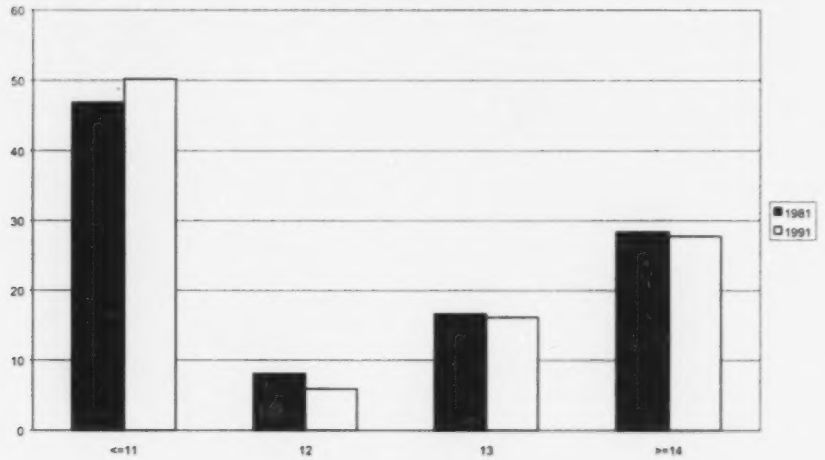


Figure 12c. High School Graduates by GED Level: Age 25-54

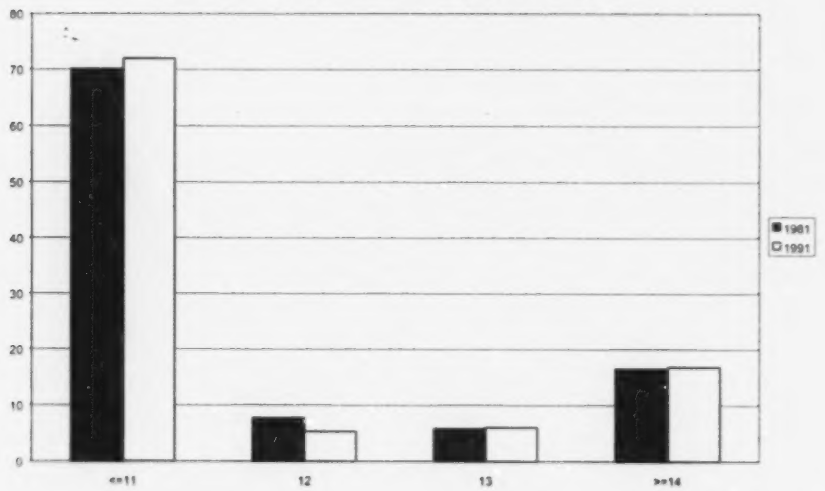
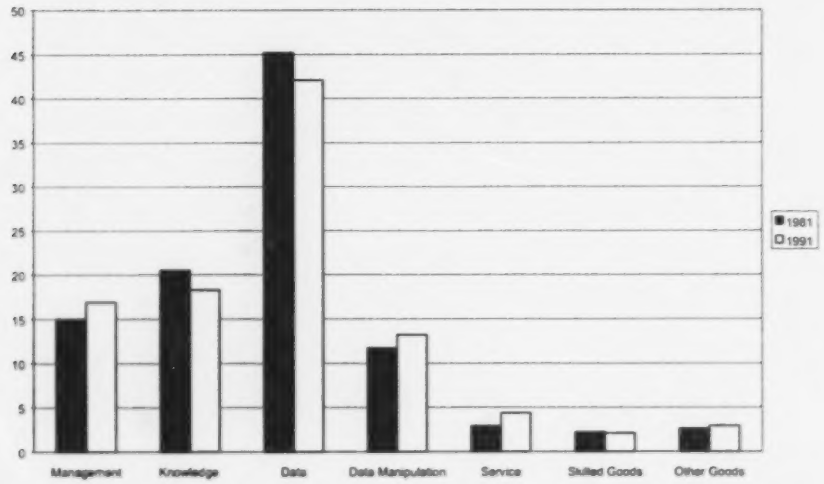


Figure 13 shows the increase in mismatch between university graduates' qualifications and the requirements of their employment in terms of our occupational categories. Overall, the

percentage of university graduates 25-54 years old employed in skilled information occupations fell from 80 percent in 1981 to 77 percent in 1991. A two percentage point increase in the proportion of university graduates working in management occupations was more than offset by a two percentage point decrease in the proportion working in knowledge occupations and a three percentage point decrease in the proportion working in data occupations.

Figure 13. Employment by Occupational Category: University Degree



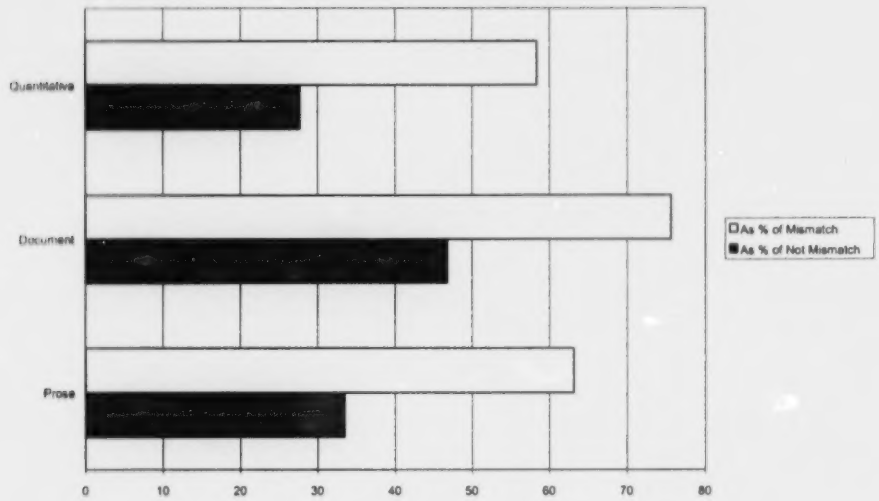
4.3 Determinants of Mismatch

Data from the Canadian panel of the IALS confirms Pryor and Schaffer's finding for the United States, that university graduates working in non-university level jobs tend to have lower levels of literacy than other university graduates. Figure 14 shows that of university graduates working outside the skilled information sector, 63 percent had prose literacy levels below level 4-5 (the highest); 76 percent had document literacy levels below level 4-5; and 58 percent had quantitative literacy levels below level 4-5. For university graduates working in the skilled information sector, the corresponding figures are 33 percent with prose literacy levels below level 4-5, 47 percent with document literacy levels below level 4-5, and 28 percent with quantitative literacy levels below literacy level 4-5.

"Mismatch" is defined as university graduates working outside the skilled information sector. A multivariate logit analysis of mismatch shows that it is also associated with characteristics other than low literacy levels. In particular, mismatch is less prevalent among workers 45-54 years old than among workers 35-44 years old, and among workers 35-44 years old than among workers

25-34 years old. (This analysis was limited to these age groups.) It is also less prevalent among workers with a degree higher than a BA than among those with a BA.

Figure 14. Percentage of University Graduates with Literacy Levels Below 4-5 by Mismatch



The results of the logit estimation are shown in Table 3. Because of the non-linearity of the logit estimator, we can only discuss these results in terms of the relative magnitudes of the estimated coefficients. The effect of increasing prose literacy scores by one level is about half that of increasing the document literacy score by one level.

Table 3: Logit Estimates of Probability of Mismatch for University Graduates

Explanatory Variable	Coefficient	SE
Constant	5.7614	0.0133
Schooling		
BA	–	–
More than BA	-1.3401	0.0056
Age		
25-34	–	–
35-44	-0.7713	0.0054
45-54	-1.6048	0.0064
Gender		
Male	–	–
Female	0.9905	0.0047
Literacy Level		
Document	-1.2772	0.0040
Prose	-0.7071	0.0036

Chi-square for covariates 550348.32 (6 dof) p=.001
n=353

The effect of a post-graduate qualification or the effect of being 45-54 years old, rather than 25-34 years old, is about the same as the effect of an increase of one level on the document literacy scale. The effect of being 35-44 years old, rather than 25-34 years old, is about the same as an increase of one level on the prose literacy scale.

Table 4 provides examples of the estimated probability of occupational mismatch for university graduates, based on the graduates' individual characteristics. The table shows, for example, that a 25-34 year old female BA with a prose literacy level of 2 and a document literacy level of 2 has a predicted probability of mismatch of 94 percent. If the literacy levels increase to 3, the predicted probability of mismatch drops to 69 percent.

Table 4: Examples of the Estimated Probability of Mismatch

Characteristics	Male (percentage)	Female (percentage)
Age 25-34		
BA		
Document and Prose Literacy Levels = 2	86	94
Document and Prose Literacy Levels = 3	45	69
Document and Prose Literacy Levels = 4-5	10	23
More than BA		
Document and Prose Literacy Levels = 2	61	81
Document and Prose Literacy Levels = 3	18	37
Document and Prose Literacy Levels = 4-5	3	7
Age 35-44		
BA		
Document and Prose Literacy Levels = 2	74	88
Document and Prose Literacy Levels = 3	28	51
Document and Prose Literacy Levels = 4-5	5	12
More than BA		
Document and Prose Literacy Levels = 2	42	66
Document and Prose Literacy Levels = 3	9	21
Document and Prose Literacy Levels = 4-5	1	4
Age 45-54		
BA		
Document and Prose Literacy Levels = 2	55	76
Document and Prose Literacy Levels = 3	14	31
Document and Prose Literacy Levels = 4-5	2	6
More than BA		
Document and Prose Literacy Levels = 2	24	46
Document and Prose Literacy Levels = 3	4	10
Document and Prose Literacy Levels = 4-5	1	2

If the literacy levels increase to 4-5, the predicted probability of mismatch drops to 23 percent. A male 25-34 year old BA with literacy levels of 4-5 has only a 10 percent predicted probability of mismatch. Finally, a 45-54 year old male with a post-graduate qualification and prose and document literacy levels of 4-5 has a predicted mismatch probability of 1 percent.

There are several possible explanations of the effects of age on mismatch. One is that the match between qualifications and job requirements improves as university graduates age, either because they acquire additional skills, or because longer periods allow better matching. Another is that the older age cohorts faced labour markets, which were more favourable for workers with university degrees. A third is that university graduates in older age cohorts had higher levels of qualifications, a possibility that will be returned to below.

Our results show that mismatch is closely connected to levels of literacy skills. To some extent, low literacy skills may be serving as a proxy for low levels of the more occupationally specific skills that are also acquired through a university education. We can conclude that mismatch is related to low levels of skills relative to the normal level for university graduates. We cannot be sure that lack of literacy skills is the most important element of low skill levels in determining mismatch, since we are unable to measure other job-related skills directly.

4.4 Earnings Consequences of Mismatch

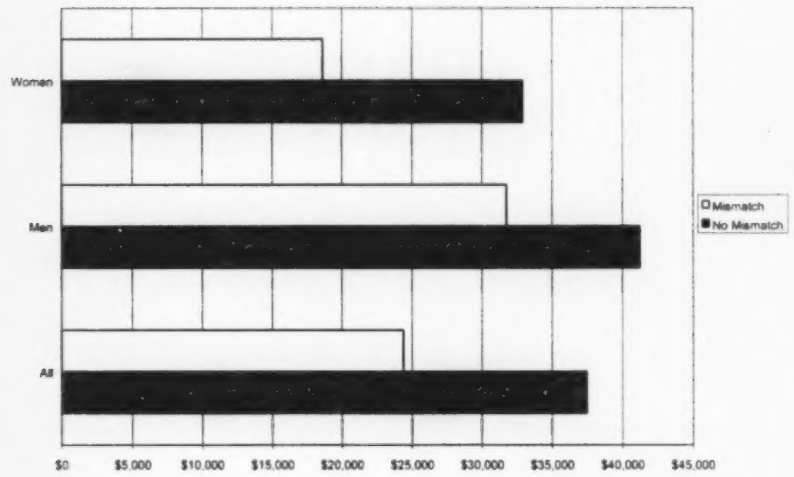
Research in the United States on mismatch between job qualifications and education for university graduates has been concerned in large part with an apparent paradox—a rising proportion of university graduates in high school jobs and contemporaneously a rising university to high school wage premium. Pryor and Schaffer (1997) claim to explain this as follows:

1) There is a rising proportion of university graduates in high school jobs.
2) The university graduates in high school jobs are those with lower literacy levels than other university graduates.
3) Wage premiums for university graduates in university jobs have increased (presumably by enough to yield an overall increase in the university-high school wage premium).

We have already seen that mismatch for university graduates increased from 1981 to 1991 and that lower levels of literacy greatly increase the probability that a university graduate worked outside the skilled information sector of the economy. The earnings consequences of mismatch between educational qualifications and job requirements will now be examined.

Figure 15 shows mean earnings from the main job in the previous twelve months by mismatch for all post-secondary graduates 25-54 years old with earnings in the IALS sample. Mismatch is defined as working in an occupation other than a skilled information occupation (management, knowledge, and data) at the main job. The figure also shows mean earnings by mismatch for women and men.

Figure 15. Mean Earnings by Mismatch: Post-Secondary Graduates Age 25-54



Mismatch is associated with about $13,000 of annual earnings loss for the overall group. The earnings loss is much larger for women (about $14,000) than for men (about $9,500).

An earnings regression is used to further examine the earnings consequences of educational level, job mismatch and literacy skills for post-secondary graduates. The results of this regression are reported in Table 5. The sample for the regression was post-secondary graduates in the Canadian IALS sample who worked full-time at their main job and had worked 52 weeks in the preceding 12 months. The dependent variable is the earnings at the main job in the preceding 12 months.

The effects of experience (age-years of completed schooling-6) and its square have the expected signs and are statistically significant.[7] Having a BA rather than a post-secondary, non-university diploma increases earnings by about $8,700; having a degree above a BA rather than a post-secondary, non-university diploma increases earnings by about $13,600. Women post-secondary graduates working full-time full-year earned about $4,200 less than did men.[8]

Table 5: Earnings Regression for Post-Secondary Graduates (Dependent Variable = Annual Earnings)

Explanatory Variable	Coefficient	t-statistic
Constant	15,472	4.555
Experience	2,088	5.488
Experience^2	-51	-4.860
Education		
Post-Secondary (non-university)	—	—
Bachelor's Degree	8,742	6.391
Greater than Bachelor's Degree	13,579	6.391
Document Literacy		
Level 1-2	1,729	.790
Level 3	—	—
Level 4-5	10,706	6.743
Gender		
Male	—	—
Female	-4,211	-2.969
Mismatch	-7,197	-4.231

R^2 = .357 (corrected for degrees of freedom)
N = 474

Occupational mismatch, as defined here, lowers earnings by approximately $7,200, when other variables affecting earnings are taken into account. Since the earnings gain from a BA (over post-secondary, non-university earnings) is approximately $8,700, the earnings gain from a BA is almost completely offset by the earnings loss if the holder of a BA works outside the skilled information sector.

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[7] In comments on an earlier draft of this paper, Scott Murray pointed out that experience measured in years is a poor proxy for skills acquired on-the-job because presence at work is not a measure of opportunities for skill investment. The finding reported above that job-related training is much more prevalent among knowledge workers than in the other occupational categories provides evidence for this view. Experience is nevertheless a conventional explanatory variable in an earnings estimation and has its expected effects in the estimate reported here.

[8] The previous section showed that women university graduates have a higher probability of mismatch than do men. Since mismatch lowers earnings, this will tend to increase the average earnings difference between otherwise observationally identical women and men.

With mismatch taken into account, having a low level (1-2) of document literacy skill has no significant direct effect on earnings. As seen earlier, however, a low level of document literacy greatly increases the probability of mismatch, thus indirectly affecting expected earnings. Even with mismatch taken into account, high levels (4-5) of document literacy skills increase earnings by around $10,700, more than the effect of a BA.

These regression results have several interesting implications. First, as previously noted, mismatch lowers earnings by enough to almost entirely offset the earnings gain from a BA. Second, a significant part of earnings differentials among persons with a post-secondary qualification is due to observable skill differentials within educational levels. High document literacy levels directly affect earnings; and document and prose literacy levels also affect earnings indirectly through their effect on mismatch. Third, among persons with a post-secondary education who work full-time, full-year, women earn significantly less than men even when other determinants of earnings—including mismatch—are taken into account. Women's earnings gap, however, is small relative to some of these other effects (for example, having a post-graduate qualification).

4.5 Why Has Mismatch Increased in Canada?

The preceding sections showed that mismatch between educational qualification and job requirements increased for university graduates in Canada between 1981 and 1991. We also showed that low levels of literacy skills greatly increase the probability of mismatch for an individual. This leaves us with the question of whether mismatch has increased because literacy levels of university graduates have decreased or for some other reason. In what follows, several possible explanations using descriptive information from the IALS and the Census are examined.

Time series data on the literacy skills of university graduates is not available.[9] In the absence of time series data, the literacy skill levels, of different birth cohorts of university graduates, as a measure of the evolution of university graduates over time are used. Figure 16a shows the percentage of university graduates post-secondary graduates and high school graduates with document literacy level 3 or 4-5 by ten year birth cohorts. Figure 16b shows the percentage of graduates with all three literacy levels 3 or 4-5.

Figure 16a. Persons with Document Literacy Level 3,4-5 as % of Educational Level by Age Group

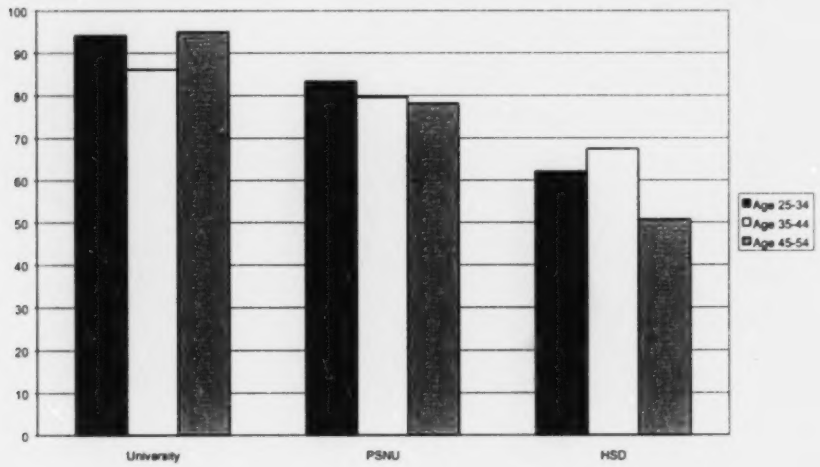
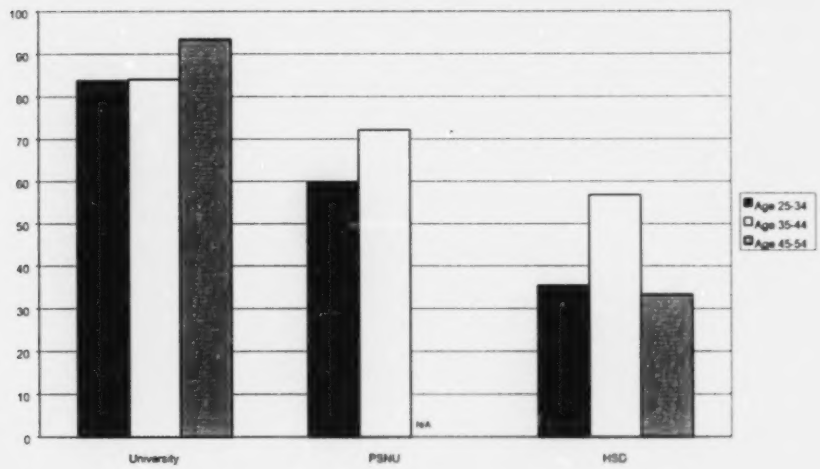


Figure 16b. Persons with All Literacy Levels 3,4-5 as % of Educational Level by Age Group



Despite the rapid increase over time in university graduates as a percentage of their birth cohort, there is little sign in Figures 16a and 16b of deterioration in the literacy skills of university graduates.[10] In particular, there is no evidence of deterioration from the cohort 25-34 years old in

[9] For Canada, literacy levels were measured in 1989 in the Survey of Literacy Skills Used in Daily Activities (LSUDA). Unfortunately it is not easy to compare the measures of literacy skills from the IALS and the LSUDA.

[10] Overall literacy levels in Figures 16a&b are higher for university graduates in the oldest birth cohort than for other cohorts. Given the relatively small samples underlying these charts and the small differences between cohorts, it seems safest to say that there is no significant change in literacy levels between cohorts of university graduates.

1994 who entered the labour market in the 1980's to the cohort 35-44 years old, who entered in the 1970's. We thus have no reason to think that increased job mismatch for university graduates is due to a deterioration of the skills of university graduates.[11]

Three alternative explanations are as follows:

1) that mismatch of university graduates increased from 1981 to 1991 because the supply of university graduates grew more rapidly than the demand for university graduates, or
2) that the qualifications of workers with lower educational qualifications increased relative to those of university graduates, resulting in increased substitution of these workers for university graduates in skilled information occupations, or
3) that the demand for university-educated workers increased in occupations outside the skilled information category due to an increase in the skill content of these occupations (upskilling).

As to the second explanation, Figures 16a and 16b do not indicate higher levels of literacy skills in more recent birth cohorts of post-secondary non-university graduates and of high school graduates. Also, Figures 12b and 12c indicate mismatch increased for post-secondary, non-university graduates and for high school graduates, as well as for university graduates. None of this supports an explanation of the increase in mismatch of university graduates based on substitution of less-educated workers for university graduates in skilled information occupations.[12]

Table 6 is used to examine the explanation of increased mismatch as a result of upskilling. The table is constructed as follows: first, a hypothetical level of paid employment of university graduates in each occupational category in 1991 is constructed. This hypothetical level assumes that the proportion of university graduates in each occupational category in 1991 is the same as in 1981, while employment in the occupational category is at its 1991 level. In other words, a fixed proportion of university graduates in each occupational category is assumed.

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[11] Hecker (1992, p8) uses U.S. data from the National Assessment of Educational Progress, Scholastic Aptitude Test and Graduate Record Examinations to argue that literacy skills of graduates have not deteriorated significantly since the 1970s.

[12] Of course other substitution-based explanations of increased mismatch of university graduates remain possible. For example, shifts in the occupational composition of skilled information occupations may have favoured occupations, which tend to employ post-secondary non-university graduates at the expense of those, which tend to employ university graduates.

Under this assumption, paid employment of university graduates would have grown by 49.7 percent from 1981 to 1991; in fact it grew by 61.8 percent over this period. This leaves a surplus of university graduates available for upskilling of occupations. The right hand column of Table 6 is derived by subtracting the hypothetical 1991 level of employment in the occupational category based on fixed requirements from the actual 1991 level of employment, then expressing this difference as a percentage of the hypothetical 1991 level. If upskilling is the only factor driving increased mismatch of university graduates, the entries in Table 6 should be measures of the upskilling of educational requirements in occupational categories.

Table 6: Excess of 1991 Paid Employment of University Graduates Relative to Fixed Requirements by Occupational Category

Occupational Category	Excess of 1991 Paid Employment of University Graduates in Category Over Fixed Requirements Level (Percentage of Fixed Requirements Level)
Management	11.3
Knowledge	-2.2
Data	1.2
Data Manipulation	40.9
Service	72.7
Skilled Goods	0.0
Other Goods	0.0
All Occupations	**8.1**

Table 6 shows that it is unlikely that upskilling is the only source of increased mismatch. The table shows that paid employment of university graduates in knowledge occupations in 1991 is 2.2 percent less than would result from a fixed proportion of university graduates in employment in these occupations. Employment of university graduates in data occupations is only 1.2 percent greater than would be implied by fixed proportions. It is difficult to believe that upskilling would bypass knowledge occupations and barely affect data occupations.

Similarly, it is difficult to believe that upskilling in data manipulation occupations is sufficient to explain why employment of university graduates in these occupations in 1991 is 40.9 percent more than would result from a fixed proportion of university graduates. (The 11.3 percent excess of university graduates in management occupations above the level implied by fixed proportions may well be the result of increased skill requirements in these occupations.)

In short, if upskilling were the only reason for increased mismatch of university graduates, it is difficult to explain downskilling in knowledge occupations, little upskilling in data occupations,

and the spectacular degree of upskilling in data manipulation occupations. There remains the explanation of insufficient growth in the demand of university graduates, relative to growth in their supply.

As noted above, from 1981 to 1991, the number of university graduates 25-54 years old in paid employment in Canada grew by 62.1 percent. Over the same period, the number of persons in paid employment in skilled information occupations grew by 53.4 percent. This suggests that the likeliest explanation for most of the increase in job mismatch from 1981 to 1991 of university-educated workers is more rapid growth in the supply of these workers than in employment in skilled information occupations. Increased job requirements (upskilling), in particular in data manipulation occupations, may have played a minor role in the increase in mismatch.

5. Conclusion: The Knowledge Content of Work

The first part of this paper attempted to develop a classification of occupations which met two goals: first, categorizing occupations in terms of their work content, in particular, the knowledge content of work; second, categorizing occupations so that the categories are distinguished by the measures of five broad skill types developed by Béjaoui (forthcoming). Following Lavoie and Roy (1998) occupations were divided into information occupations, goods occupations and service occupations. Information occupations were divided into management occupations, knowledge occupations, data occupations and data manipulation occupations. Goods occupations are divided into skilled goods occupations and other goods occupations.

Knowledge occupations are those where the work involves creating knowledge or providing expert opinion. Data occupations require the application of a high level of knowledge; data manipulation occupations require only routine manipulation of information. Like data applications, skilled goods occupations require the application of high levels of knowledge or acquired skills. They differ from data occupations in that the knowledge and skill are applied to producing goods.

An initial classification of occupations into these categories was modified on the basis of discriminant analysis. The final classification was intended to respect the division of occupations on the basis of work content described above. This classification was found to be consistent with a typology of occupations based on the skill type measures developed by Béjaoui (forthcoming).

The second part of the paper used data from the Canadian sample of the IALS to examine the work content of jobs in the occupational categories developed in the first part. A profile of the literacy levels of persons working in jobs in the occupational category was presented. In the sample from the IALS, information workers made up 56 percent of total employment. High-skilled information workers (management, knowledge, and data workers) made up 37 percent of total employment. Skilled goods workers were 10 percent of employment and other goods workers were 21 percent of employment. Service workers comprised the remaining 13 percent.

Given the high levels of cognitive skills that characterize knowledge and data occupations, it is not surprising to find that persons working in these occupations have by far the highest levels of literacy skills. Managers have lower levels of literacy skills than data workers. Data

manipulation occupations come next in literacy skills, followed by skilled goods occupations, service occupations and other goods occupations.

Several aspects of the work content of the occupational categories were examined. Using data from the IALS, the first was activities involving reading for work. The prevalence of these activities varied by activity and among occupational categories, but are generally not common in skilled information occupations. Writing activities also vary widely among occupational categories. Supervisory responsibilities and job-related training are other important aspects of work content on which the IALS collected information. It is not surprising that 80 percent of managers supervise other workers. Slightly over 60 percent of knowledge workers and 45 percent of skilled goods workers also supervise other workers. Job-related training is by far most prevalent among knowledge workers, but a significant proportion of workers in every occupational category received job-related training.

The third part of the paper examined the relationship between educational qualifications and access to skilled information occupations. It was shown that most post-secondary graduates work in skilled information occupations, while relatively few workers with a high school diploma or less work in these occupations. The level of mismatch between job requirements and education for university graduates, the relation between mismatch and literacy skills, the relation between mismatch and earnings and the sources of the apparent increase in mismatch from 1981 to 1991 was also examined.

There are several points that need to be made about these results. One is the pervasiveness of knowledge-related activities in Canadians' work lives. In every occupational category except other goods workers, at least 50 percent of workers read letters or memos for work more than once a week. More than a third of other goods workers do so as well. Sixty-five percent of the entire Canadian work force reads letters and memos for work more than once a week. While other reading and writing activities are less common, none of these activities is confined entirely to the management, knowledge and data categories of the work force.

Second, the prevalence of reading and writing activities at work varies widely with the type of activity. Overall, it is accurate to say that knowledge workers have the highest level of reading and writing activities. Skilled goods workers are the most likely to read diagrams and

schematics, however. Other activities may be more common among managers and data manipulation workers or among data workers.

Third, there is considerable overlap in the job content of the skilled information categories of managers, knowledge workers and data workers. Most knowledge workers have supervisory responsibilities, as do many data workers. There is a substantial knowledge component to the work of most managers, as is evident from the IALS results on their work activity. Knowledge and data workers have higher levels of literacy skills than managers and presumably have a higher knowledge component of their work as well. For example, far more knowledge workers than managers write reports or articles at least once a week. On the other hand, managers are more likely to have supervisory responsibilities.

Fourth, knowledge and data work obviously requires specialized skills beyond those needed for literacy-related activities. What the IALS data makes clear, however, is the importance of the role of reading, writing and quantitative manipulation in knowledge and data work. The literacy skills of these workers are essential, not only in the acquisition of their more specialized skills, but also in their work activities. To a lesser degree, the same applies to management occupations, to skilled goods occupations, to data manipulation occupations, and even to service and other goods occupations.

Fifth, job-related training is present in all occupational categories. In every category except other goods workers, over a quarter of all workers trained during the year preceding the survey. Job-related training is highly concentrated in the knowledge and data categories. This presumably reflects the need of workers in these occupations to upgrade their work-related knowledge continually.

The most surprising result with respect to job-related training is its low level among managers. A lower percentage of managers than of data manipulation workers reported receiving job-related training. Managers were only slightly more likely to receive training than service workers or skilled goods workers.

Sixth, the qualifications acquired through post-secondary education are crucial for obtaining work in the skilled information sector, particularly knowledge work. Many high school graduates have a high degree of literacy skills, but virtually none work in knowledge occupations and only

a small proportion work in data occupations or as managers. This may help explain why there are a significant number of persons with a high degree of literacy skills working in jobs which do not require the use of these skills. (See Krahn and Lowe, 1998 and Boothby, 1993).[13]

Seventh, evidence was found supporting the view that university graduates who do not work in skilled information occupations have skill levels which are lower than the average for university graduates. Working outside the skilled information had a substantial negative impact on wages for post-secondary graduates. These results agree with those of Pryor and Schaffer (1997) for the United States.

Eighth, there are indications that mismatch between educational qualifications and job requirements increased for Canadian University graduates between 1981 and 1991. This parallels the findings of studies for the United States. The evidence examined did not support explanations of increased mismatch as a result of declining skills of university graduates or as a result of increased substitution of graduates of other levels of schooling for university graduates in skilled information occupations. The likeliest explanation of increased mismatch for university graduates between 1981 and 1991 is that the number of university graduates grew more rapidly than the level of paid employment in skilled information occupations.

The profile of work activities presented here raise several issues for further research. Literacy skills are used intensively in skilled information occupations. There are other, more specific occupational qualifications, which are also acquired through post secondary education. What is the relative role of general skills such as literacy skills and more specific skills in obtaining employment in the skilled information sector? The National Graduates Survey and follow-ups could be used to investigate the importance of occupationally specific skills in obtaining skilled information work.

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[13] Krahn and Lowe (1998) find a much lower proportion of employed persons with low literacy skills working in jobs with high use of literacy skills than of employed persons with high levels of literacy skills working in jobs with low use of these skills. (Table 2.12) From their Table 2.13, it seems probable that high school graduates with high literacy skills are the greatest absolute numbers of persons in "literacy surplus" on the job for each of the three literacy skills measured in the IALS. The proportion of persons in "literacy surplus" on the job is greatest among persons with 12 years of completed schooling with high levels of document literacy skills and among persons with 17 or more years of schooling and high levels of prose and quantitative literacy skills. (Table 2.13) "Literacy surplus" on the job among persons with 17 or more years of completed schooling is very heavily concentrated among women, especially for those with high levels of prose literacy. (Figures 2.6, 2.7, 2.8)

The high level of job-related training in knowledge occupations would seem to indicate that training is a crucial element in maintaining and advancing high-level information skills. The question of training certainly deserves more attention than it has been given here. Why is training so much more prevalent in knowledge occupations than in other occupations? Is this disparity increased if the duration of training is considered? What kind of training is being taken? In occupational categories where training rates are lower, are there identifiable characteristics, which increase the likelihood of training?

A good deal remains to be done in the area of the content of information work in general and of knowledge work in particular. The types of content examined are those recorded by the IALS. This has allowed a common core of reading, writing, quantitative and supervisory activities which characterize the skilled information occupations to be identified, although present in different degrees in each of management, knowledge and data occupations. Supervisory and reading and writing activities, which characterize the work of other occupational groups, such as skilled goods occupations and data manipulation occupations were also identified.

Obviously, the skilled information occupations are differentiated from each other by activities, which are specific to these occupations. What part of the work content of each occupation lies in its specialized activities? What part lies in the common core of activities? How much of the higher earnings in certain occupations are due to greater competence in the common core of activities? What part is due to returns to specialized skills?

If we are to seek to foster the growth of a knowledge economy, we need to know what skilled information workers do and how people become skilled information workers. It is hoped that some light has been shed on what these workers do, on how their work is different from that of other groups of workers, and on the qualifications required in skilled information occupations.

Appendix A

Initial and Final Assignments of Occupations

Class	1980 SOC Code	1980 SOC Label	Initial Assignment	Final Assignment
m	1111	Members of legislative bodies	Management	Management
m	1113	Government administrators	Management	Management
m	1115	Post office management occupations	Management	Management
m	1116	Inspectors and regulatory officers, government	Management	Data
m	1119	Officials and administrators unique to government, N.E.C.	Management	Management
m	1130	General managers and other senior officials	Management	Management
m	1131	Management occs, natural sciences and engineering	Management	Management
m	1132	Management occs, social sciences and related fields	Management	Management
m	1133	Administrators in teaching and related fields	Management	Management
m	1134	Administrators in medicine and health	Management	Management
m	1135	Financial management occupations	Management	Management
m	1136	Personnel and industrial relations management occs	Management	Management
m	1137	Sales and advertising management occupations	Management	Management
m	1141	Purchasing management occupations	Management	Management
m	1142	Services management occupations	Management	Management
m	1143	Production management occupations	Management	Management
m	1145	Management occupations, construction operations	Management	Management
m	1146	Farm management occupations	Management	Management
m	1147	Management occs, transport&communications operations	Management	Management
m	1149	Others managers	Management	Management
k	1171	Accountants, auditors and other financial officers	Knowledge	Knowledge
k	1173	Organization and methods analysts	Knowledge	Knowledge
d	1174	Personnel and related officers	Data	Data
d	1175	Purchasing officers & buyers, except w/sale & retail trade	Data	Data
d	1176	Inspectors and regulatory officers, N.E.C.	Data	Data
d	1179	Occs related to management and administration, N.E.C.	Data	Data
k	2111	Chemists	Knowledge	Knowledge
k	2112	Geologists	Knowledge	Knowledge
k	2113	Physicists	Knowledge	Knowledge
k	2114	Meteorologists	Knowledge	Knowledge
d	2117	Physical sciences technologists and technicians	Data	Data
k	2119	Occupations in physical sciences, N.E.C.	Knowledge	Data
k	2131	Agriculturists and related scientists	Knowledge	Knowledge
k	2133	Biologists and related scientists	Knowledge	Knowledge
d	2135	Life sciences technologists and technicians	Data	Data
d	2139	Occupations in life sciences, N.E.C.	Data	Data
k	2141	Architects	Knowledge	Knowledge
k	2142	Chemical engineers	Knowledge	Knowledge
k	2143	Civil engineers	Knowledge	Knowledge
k	2144	Electrical engineers	Knowledge	Knowledge
k	2145	Industrial engineers	Knowledge	Knowledge
k	2146	Agricultural engineers	Knowledge	Knowledge
k	2147	Mechanical engineers	Knowledge	Knowledge
k	2151	Metallurgical engineers	Knowledge	Knowledge
k	2153	Mining engineers	Knowledge	Knowledge
k	2154	Petroleum engineers	Knowledge	Knowledge
k	2155	Aerospace engineers	Knowledge	Knowledge
k	2156	Nuclear engineers	Knowledge	Knowledge
k	2157	Community planners	Knowledge	Knowledge
k	2159	Professional engineers, N.E.C.	Knowledge	Knowledge
d	2160	Supervisors:Other occs in architecture and engineering	Data	Data
d	2161	Surveyors	Data	Data

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Appendix A (*cont.*)

Class	1980 SOC Code	1980 SOC Label	1980 SOC Label	Final Assignment
d	2163	Draughting occupations	Data	Data
d	2164	Architectural technologists and technicians	Data	Data
d	2165	Engineering technologists and technicians	Data	Data
d	2169	Other occs in architecture and engineering, N.E.C.	Data	Data
k	2181	Mathematicians, statisticians and actuaries	Knowledge	Knowledge
k	2183	Systems analysts, computer programmers & related occs	Knowledge	Data
k	2189	Occs in math,stats,systems analysis&related flds, N.E.C.	Knowledge	Data
k	2311	Economists	Knowledge	Knowledge
k	2313	Sociologists, anthropologists and related social sciences	Knowledge	Knowledge
k	2315	Psychologists	Knowledge	Knowledge
k	2319	Occupations in social sciences, N.E.C.	Knowledge	Knowledge
d	2331	Social workers	Data	Data
d	2333	Occupations in welfare and community services	Data	Data
d	2339	Occupations in social work and related fields, N.E.C.	Data	Data
k	2341	Judges and magistrates	Knowledge	Knowledge
k	2343	Lawyers and notaries	Knowledge	Knowledge
d	2349	Occupations in law and jurisprudence, N.E.C.	Data	Data Manipulation
k	2350	Supervisors:Library, museum and archival science	Knowledge	Management
k	2351	Librarians, archivists and conservators	Knowledge	Knowledge
d	2353	Technicians in library, museum and archival science	Data	Skilled Goods
d	2359	Library, museum and archival science, N.E.C.	Data	Data
d	2391	Educational and vocational counsellors	Data	Data
d	2399	Other occs in social science and related fields, N.E.C.	Data	Data
d	2511	Ministers of religion	Data	Data
s	2513	Nuns and brothers	Service	Service
s	2519	Occupations in religion, N.E.C.	Service	Service
k	2711	University teachers	Knowledge	Knowledge
d	2719	University teaching and related occupations, N.E.C.	Data	Data
d	2731	Elementary and kindergarten teachers	Data	Data
d	2733	Secondary school teachers	Data	Data
d	2739	Elem&secondary school teaching & related occs, N.E.C.	Data	Data
d	2791	Community college and vocational school teachers	Data	Data
d	2792	Fine arts teachers, N.E.C.	Data	Data
d	2793	Post-secondary school teachers, N.E.C.	Data	Data
d	2795	Teachers of exceptional students, N.E.C.	Data	Data
d	2797	Instructors and training officers, N.E.C.	Data	Data
d	2799	Other teaching and related occupations, N.E.C.	Data	Data
k	3111	Physicians and surgeons	Knowledge	Knowledge
k	3113	Dentists	Knowledge	Knowledge
d	3115	Veterinarians	Data	Data
d	3117	Osteopaths and chiropractors	Data	Data
d	3119	Health diagnosing and treating occupations, N.E.C.	Data	Data
d	3130	Supervisors:Nursing, therapy and related assisting occs	Data	Data
d	3131	Nurses, registered, graduate and nurses-in-training	Data	Data
s	3132	Orderlies	Service	Service
d	3134	Registered nursing assistants	Data	Service
s	3135	Nursing attendants	Service	Service
d	3136	Audio and speech therapists	Data	Data
d	3137	Physiotherapists	Data	Data
d	3138	Occupational therapists	Data	Data
s	3139	Nursing, therapy and related assisting occs, N.E.C.	Service	Service
d	3151	Pharmacists	Data	Data
d	3152	Dietitians and nutritionists	Data	Data
d	3153	Optometrists	Data	Data

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Appendix A (*cont.*)

Class	1980 SOC Code	1980 SOC Label	1980 SOC Label	Final Assignment
g	3154	Dispensing opticians	Other Goods	Skilled Goods
d	3155	Radiological technologists and technicians	Data	Data
d	3156	Medical laboratory technologists and technicians	Data	Data
g	3157	Denturists	Other Goods	Skilled Goods
s	3158	Dental hygienists and dental assistants	Service	Service
g	3161	Dental laboratory technicians	Other Goods	Skilled Goods
d	3162	Respiratory technicians	Data	Service
d	3169	Other occupations in medicine and health, N.E.C.	Data	Data
k	3311	Painters, sculptors and related artists	Knowledge	Knowledge
d	3313	Product and interior designers	Data	Data
d	3314	Advertising and illustrating artists	Data	Data
d	3315	Photographers and camera operators	Data	Skilled Goods
d	3319	Occs in fine&commercial art, photography&related, N.E.C.	Data	Skilled Goods
k	3330	Producers, directors, performing and audio-visual arts	Knowledge	Management
k	3331	Conductors, composers and arrangers	Knowledge	Knowledge
d	3332	Musicians and singers	Data	Knowledge
d	3333	Occs related to music and musical entertainment, N.E.C.	Data	Data
d	3334	Dancers and choreographers	Data	Data
d	3335	Actors/actresses	Data	Data
d	3337	Radio and television announcers	Data	Data
d	3339	Occupations in performing and audio-visual arts, N.E.C.	Data	Service
k	3351	Writers and editors	Knowledge	Knowledge
d	3355	Translators and interpreters	Data	Data
d	3359	Occupations in writing, N.E.C.	Data	Data
d	3360	Supervisors:Occupations in sports and recreation	Data	Data
d	3370	Coaches, trainers and instructors, sports and recreation	Data	Data
d	3371	Referees and related officials	Data	Data
d	3373	Athletes	Data	Data
s	3375	Attendants, sports and recreation	Service	Service
s	3379	Occupations in sports and recreation, N.E.C.	Service	Service
a	4110	Supervisors:Stenographic and typing occupations	Data Manipulation	Data Manipulation
a	4111	Secretaries and stenographers	Data Manipulation	Data Manipulation
a	4113	Typists and clerk-typists	Data Manipulation	Data Manipulation
a	4130	Supervisors:Bookkeeping, account-recording&related occs	Data Manipulation	Data Manipulation
a	4131	Bookkeepers and accounting clerks	Data Manipulation	Data Manipulation
a	4133	Cashiers and tellers	Data Manipulation	Data Manipulation
a	4135	Insurance, bank and other finance clerks	Data Manipulation	Data Manipulation
a	4137	Statistical clerks	Data Manipulation	Data Manipulation
a	4139	Bookkeeping, account-recording and related occs, N.E.C.	Data Manipulation	Data Manipulation
a	4140	Supervisors:Office machine and EDP equipment operators	Data Manipulation	Data Manipulation
a	4141	Office machine operators	Data Manipulation	Data Manipulation
a	4143	Electronic data-processing equipment operators	Data Manipulation	Other Goods
a	4150	Supers:Material recording, scheduling & distributing occs	Data Manipulation	Data Manipulation
a	4151	Production clerks	Data Manipulation	Data Manipulation
a	4153	Shipping and receiving clerks	Data Manipulation	Data Manipulation
a	4155	Stock clerks and related occupations	Data Manipulation	Data Manipulation
a	4157	Weighers	Data Manipulation	Data Manipulation
a	4159	Material recording, scheduling & distributing occs, N.E.C.	Data Manipulation	Data Manipulation
a	4160	Supers:Library, file&correspondence clerks&related occs	Data Manipulation	Data Manipulation
a	4161	Library and file clerks	Data Manipulation	Data Manipulation
a	4169	Library, file & correspondence clerks&related occs, N.E.C.	Data Manipulation	Data Manipulation
a	4170	Supers:Reception, info, mail&message distribution occs	Data Manipulation	Data Manipulation
a	4171	Receptionists and information clerks	Data Manipulation	Data Manipulation
a	4172	Mail carriers	Data Manipulation	Service

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Appendix A (*cont.*)

Class	1980 SOC Code	1980 SOC Label	1980 SOC Label	Final Assignment
a	4173	Mail and postal clerks	Data Manipulation	Data Manipulation
a	4175	Telephone operators	Data Manipulation	Service
a	4177	Messengers	Data Manipulation	Service
a	4179	Reception, info, mail & message distribution occs, N.E.C.	Data Manipulation	Data Manipulation
a	4190	Supervisors:Other clerical, related occs, N.E.C.	Data Manipulation	Data Manipulation
a	4191	Collectors	Data Manipulation	Data Manipulation
a	4192	Claim adjusters	Data Manipulation	Data Manipulation
a	4193	Travel clerks, ticket, station, freight agents	Data Manipulation	Data Manipulation
a	4194	Hotel clerks	Data Manipulation	Service
a	4195	Personnel clerks	Data Manipulation	Data Manipulation
a	4197	General office clerks	Data Manipulation	Data Manipulation
a	4199	Other clerical and related occupations, N.E.C.	Data Manipulation	Data Manipulation
a	5130	Supervisors:Sales occupations, commodities	Data Manipulation	Management
a	5131	Technical sales occupations and related advisers	Data Manipulation	Data
a	5133	Commercial travellers	Data Manipulation	Data Manipulation
s	5135	Sales clerks and salespersons, commodities, N.E.C.	Service	Data Manipulation
s	5141	Street vendors and door-to-door sales occupations	Service	Service
s	5143	Newspaper carriers and vendors	Service	Service
s	5145	Service station attendants	Service	Service
s	5149	Sales occupations:Commodities, N.E.C.	Service	Service
a	5170	Supervisors:Sales occupations, services	Data Manipulation	Management
a	5171	Insurance sales occupations	Data Manipulation	Data Manipulation
a	5172	Real estate sales occupations	Data Manipulation	Data Manipulation
a	5173	Sales agents and traders, securities	Data Manipulation	Data Manipulation
a	5174	Advertising sales occupations	Data Manipulation	Data Manipulation
a	5177	Business services sales occupations	Data Manipulation	Data Manipulation
a	5179	Sales occupations:Services, N.E.C.	Data Manipulation	Data Manipulation
a	5190	Supervisors:Other sales occupations	Data Manipulation	Data Manipulation
a	5191	Buyers, wholesale and retail trade	Data Manipulation	Data
g	5193	Route drivers	Other Goods	Service
a	5199	Other sales occupations, N.E.C.	Data Manipulation	Data Manipulation
s	6111	Fire-fighting occupations	Service	Service
s	6112	Police officers and detectives, government	Service	Service
s	6113	Police agents and investigators, private	Service	Service
s	6115	Guards and related security occupations	Service	Service
s	6119	Protective service occupations, N.E.C.	Service	Service
s	6120	Supers:Food&beverage preparation&related service occs	Service	Service
s	6121	Chefs and cooks	Service	Other Goods
s	6123	Bartenders	Service	Service
s	6125	Food and beverage serving occupations	Service	Service
s	6129	Food&beverage preparation&related service occs, N.E.C.	Service	Service
s	6130	Supervisors:Lodging and other accommodation	Service	Service
s	6133	Lodging cleaners, except private household	Service	Service
s	6135	Sleeping-car and baggage porters	Service	Service
s	6139	Occupations in lodging and other accommodation, N.E.C.	Service	Service
d	6141	Funeral directors, embalmers and related occs	Data	Data
s	6142	Housekeepers, servants and related occupations	Service	Service
s	6143	Barbers, hairdressers and related occupations	Service	Service
s	6144	Guides	Service	Service
s	6145	Travel and related attendants, except food and beverage	Service	Service
s	6147	Child-care occupations	Service	Service
s	6149	Personal service occupations, N.E.C.	Service	Service
s	6160	Supervisors:Apparel and furnishings service occupations	Service	Other Goods
s	6162	Laundering and dry cleaning occupations	Service	Other Goods

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Appendix A (*cont.*)

Class	1980 SOC Code	1980 SOC Label	1980 SOC Label	Final Assignment
s	6165	Pressing occupations	Service	Other Goods
s	6169	Apparel and furnishings service occupations, N.E.C.	Service	Other Goods
s	6190	Supervisors:Other service occupations	Service	Service
s	6191	Janitors, charworkers and cleaners	Service	Service
s	6193	Elevator-operating occupations	Service	Service
s	6198	Labouring and other elemental work:Other services	Service	Service
s	6199	Other service occupations, N.E.C.	Service	Service
c	7111	Farmers	Skilled Goods	Skilled Goods
g	7180	Foremn/womn:Other farming, horticultural&animal hsbdry	Other Goods	Skilled Goods
g	7183	Livestock farm workers	Other Goods	Other Goods
g	7185	Crop farm workers	Other Goods	Other Goods
g	7195	Nursery and related workers	Other Goods	Other Goods
g	7196	Inspecting&testing&grading&sampling occs:Other farming	Other Goods	Other Goods
g	7197	Farm machinery operators	Other Goods	Other Goods
g	7199	Other farming, horticultural and animal husbandry, N.E.C.	Other Goods	Other Goods
c	7311	Captains and other officers, fishing vessels	Skilled Goods	Skilled Goods
g	7313	Net, trap and line fishing occupations	Other Goods	Other Goods
g	7315	Trapping and related occupations	Other Goods	Skilled Goods
g	7319	Fishing, trapping and related occupations, N.E.C.	Other Goods	Other Goods
g	7510	Foremen/women:Forestry and logging occupations	Other Goods	Skilled Goods
g	7511	Forestry conservation occupations	Other Goods	Other Goods
g	7513	Timber cutting and related occupations	Other Goods	Other Goods
g	7516	Log inspecting, grading, scaling, related occs	Other Goods	Other Goods
g	7517	Log hoisting, sorting, moving and related occs	Other Goods	Other Goods
g	7518	Labouring and other elemental work:Forestry and logging	Other Goods	Other Goods
g	7519	Forestry and logging occupations, N.E.C.	Other Goods	Other Goods
g	7710	Foremen/women:Mining&quarrying inc. oil&gas field occs	Other Goods	Skilled Goods
g	7711	Rotary well-drilling and related occupations	Other Goods	Other Goods
g	7713	Rock and soil drilling occupations	Other Goods	Other Goods
g	7715	Blasting occupations	Other Goods	Other Goods
g	7717	Mining and quarrying:Cutting,handling,loading occs	Other Goods	Other Goods
g	7718	Labouring and other elemental work:Mining and quarrying	Other Goods	Other Goods
g	7719	Mining and quarrying including oil and gas field, N.E.C.	Other Goods	Other Goods
g	8110	Foremen/women:Mineral ore treating occupations	Other Goods	Skilled Goods
g	8111	Crushing and grinding occupations, mineral ores	Other Goods	Other Goods
g	8113	Mixing, separating, filtering and related, mineral ores	Other Goods	Other Goods
g	8115	Melting and roasting occupations, mineral ores	Other Goods	Other Goods
g	8116	Inspecting, testing, grading & sampling occs:Mineral ore	Other Goods	Other Goods
g	8118	Labouring and other elemental work:Mineral ore	Other Goods	Other Goods
g	8119	Mineral ore treating occupations, N.E.C.	Other Goods	Other Goods
g	8130	Foremen/women:Metal processing and related occs	Other Goods	Skilled Goods
g	8131	Metal smelting, converting and refining occs	Other Goods	Other Goods
g	8133	Metal heat-treating occupations	Other Goods	Other Goods
g	8135	Metal rolling occupations	Other Goods	Other Goods
g	8137	Moulding, coremaking and metal casting occupations	Other Goods	Other Goods
g	8141	Metal extruding and drawing occupations	Other Goods	Other Goods
g	8143	Plating, metal spraying and related occupations	Other Goods	Other Goods
g	8146	Inspecting, testing, grading & sampling occs, metal proc.	Other Goods	Other Goods
g	8148	Labouring and other elemental work:Metal processing	Other Goods	Other Goods
g	8149	Metal processing and related occupations, N.E.C.	Other Goods	Other Goods
g	8150	Foremn/wmn:Clay, glass&stone processing, forming&rltd	Other Goods	Skilled Goods
g	8151	Furnace and kiln workers:Clay, glass and stone	Other Goods	Other Goods
g	8153	Separating, grinding, crushing&mixing:Clay, glass&stone	Other Goods	Other Goods
g	8155	Forming occupations:Clay, glass and stone	Other Goods	Other Goods

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Appendix A (*cont.*)

Class	1980 SOC Code	1980 SOC Label	1980 SOC Label	Final Assignment
g	8156	Inspecting, testing, grading&sampling:Clay, glass&stone	Other Goods	Other Goods
g	8158	Labouring and other elemental work:Clay, glass and stone	Other Goods	Other Goods
g	8159	Clay, glass&stone processing, forming&rltd occs, N.E.C.	Other Goods	Other Goods
g	8160	Foremen/women:Chemicals, ptrlm, rbbr&plstic processing	Other Goods	Skilled Goods
g	8161	Mixing & blending occs, chemicals & related materials	Other Goods	Other Goods
g	8163	Filtering, straining&separating, chemicals&rltd materials	Other Goods	Other Goods
g	8165	Distilling, subliming, carbonizing, chemcls&rltd materials	Other Goods	Other Goods
g	8167	Roasting, cooking & drying, chemicals&related materials	Other Goods	Other Goods
g	8171	Crushing&grinding, chemicals&related materials	Other Goods	Other Goods
g	8173	Coating&calendering, chemicals&related materials	Other Goods	Other Goods
g	8176	Inspecting, testing, grading&sampling:Chemcls&rltd mtrls	Other Goods	Other Goods
g	8178	Labouring&other elemental work:Chemicals&rltd materials	Other Goods	Other Goods
g	8179	Chemicals & related materials processing occs, N.E.C.	Other Goods	Other Goods
g	8210	Foremen/women:Food, beverage&related processing occs	Other Goods	Skilled Goods
g	8211	Flour and grain milling occupations	Other Goods	Other Goods
g	8213	Baking, confectionery making and related occs	Other Goods	Other Goods
g	8215	Slaughtering&meat cutting, canning, curing&packing occs	Other Goods	Other Goods
g	8217	Fish canning, curing and packing occupations	Other Goods	Other Goods
g	8221	Fruit and vegetable canning, preserving and packing occs	Other Goods	Other Goods
g	8223	Milk processing and related occupations	Other Goods	Other Goods
g	8225	Sugar processing and related occupations	Other Goods	Other Goods
g	8226	Inspecting, testing, grading&sampling:Food&beverage	Other Goods	Other Goods
g	8227	Beverage processing and related occupations	Other Goods	Other Goods
g	8228	Labouring&other elemental work:Food&beverage	Other Goods	Other Goods
g	8229	Food, beverage and related processing occs, N.E.C.	Other Goods	Other Goods
g	8230	Foremen/women:Wood processing, except pulp & paper	Other Goods	Skilled Goods
g	8231	Sawmill sawyers and related occupations	Other Goods	Other Goods
g	8233	Plywood making and related occupations	Other Goods	Other Goods
g	8235	Wood treating occupations	Other Goods	Other Goods
g	8236	Inspecting, testing, grading&sampling occs:Wood proc.	Other Goods	Other Goods
g	8238	Labouring & other elemental work: Wood processing	Other Goods	Other Goods
g	8239	Wood processing, except pulp & papermaking, N.E.C.	Other Goods	Other Goods
g	8250	Foremen/women:Pulp & papermaking & related occs	Other Goods	Skilled Goods
g	8251	Cellulose pulp preparing occupations	Other Goods	Other Goods
g	8253	Papermaking and finishing occupations	Other Goods	Other Goods
g	8256	Inspecting, testing, grading & sampling occs:Pulp & paper	Other Goods	Other Goods
g	8258	Labouring & other elemental work:Pulp & paper	Other Goods	Other Goods
g	8259	Pulp and papermaking and related occs, N.E.C.	Other Goods	Other Goods
g	8260	Foremen/women:Textile processing occupations	Other Goods	Skilled Goods
g	8261	Textile fibre preparing occupations	Other Goods	Other Goods
g	8263	Textile spinning and twisting occupations	Other Goods	Other Goods
g	8265	Textile winding and reeling occupations	Other Goods	Other Goods
g	8267	Textile weaving occupations	Other Goods	Other Goods
g	8271	Knitting occupations	Other Goods	Other Goods
g	8273	Textile bleaching and dyeing occupations	Other Goods	Other Goods
g	8275	Textile finishing and calendering occupations	Other Goods	Other Goods
g	8276	Inspecting, testing, grading & sampling occs, textile proc.	Other Goods	Other Goods
g	8278	Labouring and other elemental work:Textile processing	Other Goods	Other Goods
g	8279	Textile processing occupations, N.E.C.	Other Goods	Other Goods
g	8290	Foremen/women:Other processing occupations	Other Goods	Skilled Goods
g	8293	Tobacco processing occupations	Other Goods	Other Goods
g	8295	Hide and pelt processing occupations	Other Goods	Other Goods
g	8296	Inspectng, testing, gradng & samplng occs:Process N.E.C.	Other Goods	Other Goods
g	8298	Labouring and other elemental work:Other processing	Other Goods	Other Goods

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Appendix A (*cont.*)

Class	1980 SOC Code	1980 SOC Label	1980 SOC Label	Final Assignment
g	8299	Other processing occupations, N.E.C.	Other Goods	Other Goods
g	8310	Foremen/women:Metal machining occupations	Other Goods	Skilled Goods
c	8311	Tool and die making occupations	Skilled Goods	Skilled Goods
c	8313	Machinist and machine tool setting-up occupations	Skilled Goods	Skilled Goods
g	8315	Machine tool operating occupations	Other Goods	Other Goods
g	8316	Inspecting, testing, grdng&sampling occs:Metal machining	Other Goods	Skilled Goods
g	8319	Metal machining occupations, N.E.C.	Other Goods	Other Goods
g	8330	Foremen/women:Metal shaping&forming, expt machining	Other Goods	Skilled Goods
g	8331	Forging occupations	Other Goods	Other Goods
g	8333	Sheet metal workers	Other Goods	Skilled Goods
g	8334	Metalworking-machine operators, N.E.C.	Other Goods	Other Goods
g	8335	Welding and flame cutting occupations	Other Goods	Other Goods
g	8336	Inspecting, testing, grdng&smplng:Metal shaping&forming	Other Goods	Other Goods
g	8337	Boilermakers, platers and structural metal workers	Other Goods	Skilled Goods
g	8339	Metal shaping & forming occs, except machining, N.E.C.	Other Goods	Other Goods
g	8350	Foremen/women:Wood machining occupations	Other Goods	Skilled Goods
g	8351	Wood patternmaking occupations	Other Goods	Skilled Goods
g	8353	Wood sawing and related occupations, N.E.C.	Other Goods	Other Goods
g	8355	Planing, turning, shaping & related wood machining occs	Other Goods	Other Goods
g	8356	Inspectng, testng, grdng & sampling occs:Wood machining	Other Goods	Other Goods
g	8357	Wood sanding occupations	Other Goods	Other Goods
g	8359	Wood machining occupations, N.E.C.	Other Goods	Other Goods
g	8370	Foremn/wmn:Clay, glass, stone & rltd materials machining	Other Goods	Skilled Goods
g	8371	Cutting&shaping:Clay, glass, stone & related materials	Other Goods	Other Goods
g	8373	Abrading&polishing:Clay, glass, stone & related materials	Other Goods	Other Goods
g	8376	Inspecting, testing, grading&sampling:Clay, glass&stone	Other Goods	Other Goods
g	8379	Clay, glass, stone & related materials machining, N.E.C.	Other Goods	Other Goods
g	8390	Foremen/women:Other machining and related occs, N.E.C.	Other Goods	Skilled Goods
g	8391	Engravers, etchers and related occs, N.E.C.	Other Goods	Other Goods
g	8393	Filing, grinding, buffing, cleaning and polishing, N.E.C.	Other Goods	Other Goods
g	8395	Patternmakers and mouldmakers, N.E.C.	Other Goods	Skilled Goods
g	8396	Inspctng, testng, gradng & smplng:Other machining, N.E.C.	Other Goods	Other Goods
g	8399	Other machining and related occupations, N.E.C.	Other Goods	Skilled Goods
g	8510	Foremn/wmn:Fabricating&assembling, metal prods, N.E.C.	Other Goods	Skilled Goods
g	8511	Engine&related equipment fabricating&assembling, N.E.C.	Other Goods	Other Goods
g	8513	Motor vehicle fabricating and assembling, N.E.C.	Other Goods	Other Goods
g	8515	Aircraft fabricating and assembling occs, N.E.C.	Other Goods	Skilled Goods
g	8523	Mechanized equipment fabricating and assmbling, N.E.C.	Other Goods	Other Goods
g	8525	Business&commercl machines fbrctng&assmblng, N.E.C.	Other Goods	Other Goods
g	8526	Inspctng, testng, grdng&smplng:Fbrctng&assmblng N.E.C.	Other Goods	Other Goods
g	8527	Precision instrmnts&rltd equipment fbrtg&asmblg, N.E.C.	Other Goods	Other Goods
g	8528	Labouring&other elemental work:Fabrctng&asmblng N.E.C.	Other Goods	Other Goods
g	8529	Other fabricating and assembling:Metal products, N.E.C.	Other Goods	Other Goods
g	8530	Foremn/wmn:Fabricating&assembling:Elec.&rltd equipmnt	Other Goods	Skilled Goods
g	8531	Electrical & related equipment fabricating & assembling	Other Goods	Other Goods
g	8533	Electrical&related equipment installing&repairing, N.E.C.	Other Goods	Skilled Goods
g	8534	Electronic ? related equipment fabricating & assembling	Other Goods	Other Goods
g	8535	Electronic&related equipment installing&repairing, N.E.C.	Other Goods	Skilled Goods
g	8536	Inspecting&related:Fabricating&rltd, elctrcl&rltd equipment	Other Goods	Other Goods
g	8537	Radio and television repairers	Other Goods	Skilled Goods
g	8538	Labouring&other:Fabricating&rltd, elctrcl&rltd equipment	Other Goods	Other Goods
g	8539	Fabricating&related:Electrical&related equipment, N.E.C.	Other Goods	Other Goods
g	8540	Foremn/wmn:Fabricating, assemb.&repairing:Wood prods	Other Goods	Skilled Goods
g	8541	Cabinet and wood furniture makers	Other Goods	Other Goods

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Appendix A (*cont.*)

Class	1980 SOC Code	1980 SOC Label	1980 SOC Label	Final Assignment
g	8546	Inspecting&rltd:Fabricating, assembling&repairing, wood	Other Goods	Skilled Goods
g	8548	Labouring:Fabricating, assembling&repairing, wood prods	Other Goods	Other Goods
g	8549	Fabricating, assembling & repairing:Wood prods, N.E.C.	Other Goods	Other Goods
g	8550	Foremn/wmn:Fabricating & rltd:Textile, fur & leather prods	Other Goods	Skilled Goods
g	8551	Patternmaking, marking&cutting:Textile, fur&leather prods	Other Goods	Other Goods
g	8553	Tailors and dressmakers	Other Goods	Skilled Goods
g	8555	Furriers	Other Goods	Skilled Goods
g	8557	Milliners, hat and cap makers	Other Goods	Other Goods
g	8561	Shoemaking and repairing occupations	Other Goods	Other Goods
g	8562	Upholsterers	Other Goods	Other Goods
g	8563	Sewing machine operators, textile materials	Other Goods	Other Goods
g	8566	Inspecting&rltd occs:Fabricating&rltd, textile, fur&leather	Other Goods	Other Goods
g	8568	Labouring:Fabricating, assmbing&repairng, txtle, fur&lthr	Other Goods	Other Goods
g	8569	Fabricating&related:Textile, fur&leather products, N.E.C.	Other Goods	Other Goods
g	8570	Foremn/wmn:Fabricating&rltd:Rubber&rltd prods, N.E.C.	Other Goods	Skilled Goods
g	8571	Bonding&cementing:Rubber, plastic&related products	Other Goods	Other Goods
g	8573	Moulding:Rubber, plastic and related products	Other Goods	Other Goods
g	8575	Cutting & finishing:Rubber, plastic & related products	Other Goods	Other Goods
g	8576	Inspecting&related:Fabricating&rltd, rubber&rltd products	Other Goods	Other Goods
g	8578	Labouring:Fabricating & rltd, rubber, plastic & rltd products	Other Goods	Other Goods
g	8579	Fabricating, assembling&repairing:Rbbr&rltd prods, N.E.C.	Other Goods	Other Goods
g	8580	Foremen/women:Mechanics and repairers, N.E.C.	Other Goods	Skilled Goods
g	8581	Motor vehicle mechanics and repairers	Other Goods	Other Goods
c	8582	Aircraft mechanics and repairers	Skilled Goods	Skilled Goods
g	8583	Rail transport equipment mechanics and repairers	Other Goods	Skilled Goods
g	8584	Industrial, farm&construction machinery mechanics&reprs	Other Goods	Skilled Goods
g	8585	Business&commercial machine mechanics&repairers	Other Goods	Skilled Goods
g	8586	Inspecting & related occupations:Equipment repair, N.E.C.	Other Goods	Other Goods
g	8587	Watch and clock repairers	Other Goods	Other Goods
c	8588	Precision instrument mechanics and repairers	Skilled Goods	Skilled Goods
g	8589	Other mechanics and repairers, N.E.C.	Other Goods	Other Goods
g	8590	Foremn/wmn:Other product fabricating, assmbing & reprng	Other Goods	Skilled Goods
g	8591	Jewellery & silverware fabricating, assmbling & repairing	Other Goods	Other Goods
g	8592	Marine craft fabricating, assembling and repairng	Other Goods	Other Goods
g	8593	Paper product fabricating and assembling occupations	Other Goods	Other Goods
g	8595	Painting and decorating occupations, N.E.C.	Other Goods	Other Goods
g	8596	Inspctng&rltd:Other product fabrictng, assmbing&repairng	Other Goods	Other Goods
g	8598	Labouring:Other product fabricating, assembling&repairng	Other Goods	Other Goods
g	8599	Other product fabricating, assmbling & repairing, N.E.C.	Other Goods	Other Goods
g	8710	Foremen/women:Excavating, grading, paving and related	Other Goods	Skilled Goods
g	8711	Excavating, grading and related occupations	Other Goods	Other Goods
g	8713	Paving, surfacing and related occupations	Other Goods	Other Goods
g	8715	Railway section and track workers	Other Goods	Other Goods
g	8718	Labouring:Excavating, grading, paving & related activities	Other Goods	Other Goods
g	8719	Excavating, grading, paving and related occs, N.E.C.	Other Goods	Other Goods
c	8730	Foremn/wmn:Electricl power, erecting, installing&repairing	Skilled Goods	Skilled Goods
c	8731	Electrical power line workers and related occupations	Skilled Goods	Skilled Goods
c	8733	Construction electricians and repairers	Skilled Goods	Skilled Goods
g	8735	Wire communications&rltd equipment installing&repairing	Other Goods	Skilled Goods
c	8736	Inspecting&rltd:Elect power, erecting, installing&repairing	Skilled Goods	Skilled Goods
g	8738	Labouring:Electrical power, erecting, installing&repairing	Other Goods	Other Goods
g	8739	Elect power&wire comms equipment erecting&rltd, N.E.C.	Other Goods	Skilled Goods
c	8780	Foremen/women:Other construction trades occupations	Skilled Goods	Skilled Goods
c	8781	Carpenters and related occupations	Skilled Goods	Skilled Goods

Appendix A (*cont.*)

Class	1980 SOC Code	1980 SOC Label	1980 SOC Label	Final Assignment
c	8782	Brick and stone masons and tile setters	Skilled Goods	Other Goods
g	8783	Concrete finishing and related occupations	Other Goods	Other Goods
g	8784	Plasterers and related occupations	Other Goods	Skilled Goods
g	8785	Painters, paperhangers and related occupations	Other Goods	Other Goods
g	8786	Insulating occupations, construction	Other Goods	Other Goods
g	8787	Roofing, waterproofing and related occupations	Other Goods	Other Goods
c	8791	Pipefitting, plumbing and related occupations	Skilled Goods	Skilled Goods
g	8793	Structural metal erectors	Other Goods	Other Goods
g	8795	Glaziers	Other Goods	Skilled Goods
c	8796	Inspect, testng, gradng&smplng:Other construction trades	Skilled Goods	Skilled Goods
g	8798	Labouring:Other construction trades	Other Goods	Other Goods
g	8799	Other construction trades occupations, N.E.C.	Other Goods	Other Goods
d	9110	Foremen/women:Air transport operating occupations	Data	Data
d	9111	Air pilots, navigators and flight engineers	Data	Data
d	9113	Air transport operating support occupations	Data	Data
g	9119	Air transport operating occupations, N.E.C.	Other Goods	Service
c	9130	Foremen/women:Railway transport operating occupations	Skilled Goods	Skilled Goods
c	9131	Locomotive operating occupations	Skilled Goods	Skilled Goods
c	9133	Conductors and brake workers, railway	Skilled Goods	Service
c	9135	Railway transport operating support occupations	Skilled Goods	Data Manipulation
g	9139	Railway transport operating occupations, N.E.C.	Other Goods	Other Goods
d	9151	Deck officers	Data	Data
d	9153	Engineering officers, ship	Data	Skilled Goods
g	9155	Deck crew, ship	Other Goods	Other Goods
g	9157	Engine and boiler-room crew, ship	Other Goods	Other Goods
g	9159	Water transport operating occupations, N.E.C.	Other Goods	Other Goods
g	9170	Foremen/women:Motor transport operating occupations	Other Goods	Skilled Goods
g	9171	Bus drivers	Other Goods	Service
s	9173	Taxi drivers and chauffeurs	Service	Service
g	9175	Truck drivers	Other Goods	Other Goods
g	9179	Motor transport operating occupations, N.E.C.	Other Goods	Other Goods
g	9190	Foremen/women:Other transport equipment operatng occs	Other Goods	Skilled Goods
g	9191	Subway and street railway operating occupations	Other Goods	Service
g	9193	Rail vehicle operators, except rail transport	Other Goods	Other Goods
g	9199	Other transport equipment operating occupations, N.E.C.	Other Goods	Other Goods
g	9310	Foremen/women:Material handling and related, N.E.C.	Other Goods	Skilled Goods
g	9311	Hoisting occupations, N.E.C.	Other Goods	Other Goods
g	9313	Longshore workers, stevedores, freight handlers	Other Goods	Other Goods
g	9314	Parcel carriers, N.E.C.	Other Goods	Other Goods
g	9315	Material handling equipment operators, N.E.C.	Other Goods	Other Goods
g	9317	Packaging occupations, N.E.C.	Other Goods	Other Goods
g	9318	Labouring:Material handling & related activities, N.E.C.	Other Goods	Other Goods
g	9319	Other material handling and related occs, N.E.C.	Other Goods	Other Goods
c	9510	Foremen/women:Printing and related occupations	Skilled Goods	Skilled Goods
c	9511	Typesetting and composing occupations	Skilled Goods	Skilled Goods
c	9512	Printing press occupations	Skilled Goods	Skilled Goods
c	9513	Stereotyping and electrotyping occupations	Skilled Goods	Skilled Goods
c	9514	Printing engraving, except photoengraving, occupations	Skilled Goods	Skilled Goods
c	9515	Photoengraving and related occupations	Skilled Goods	Skilled Goods
g	9517	Bookbinding and related occupations	Other Goods	Other Goods
g	9518	Labouring:Printing and related activities	Other Goods	Other Goods
g	9519	Printing and related occupations, N.E.C.	Other Goods	Other Goods
c	9530	Foremn/wmn:Stationary eng. & utilities equipment op&rltd	Skilled Goods	Skilled Goods
c	9531	Power station operators	Skilled Goods	Skilled Goods

Appendix A (*cont.*)

Class	1980 SOC Code	1980 SOC Label	1980 SOC Label	Final Assignment
c	9539	Stationary eng. & utilities equipment op & related, N.E.C.	Skilled Goods	Other Goods
c	9550	Foremn/wmn:Electronic&rltd comms equipment op, N.E.C.	Skilled Goods	Skilled Goods
c	9551	Radio and television broadcasting equipment operators	Skilled Goods	Skilled Goods
g	9553	Telegraph operators	Other Goods	Data Manipulation
c	9555	Sound&video recording&reproduction equipmnt operators	Skilled Goods	Skilled Goods
g	9557	Motion picture projectionists	Other Goods	Skilled Goods
g	9559	Other electronic&rltd comms equipment operating, N.E.C.	Other Goods	Skilled Goods
g	9590	Foremen/women:Other crafts&equipment operating, N.E.C.	Other Goods	Skilled Goods
g	9591	Photographic processing occupations	Other Goods	Other Goods
g	9599	Other crafts and equipment operating occs, N.E.C.	Other Goods	Other Goods
g	9910	Supervisors and foremen/women, N.E.C.	Other Goods	Skilled Goods
g	9916	Inspecting, testing, grading and sampling, N.E.C.	Other Goods	Other Goods
g	9918	Occupations in Labouring & Other Elemental Work, N.E.C.	Other Goods	Other Goods
g	9919	Other Occupations, N.E.C.	Other Goods	Service

Appendix B

Output of Discriminant Analysis

The SAS output which follows shows the result of discriminant analysis using SAS PROC DISCRIM. The class assignments used are the final assignments shown in Appendix A. The scores used to classify the observations are the five skill type scores.

Table B.1

Class Name Abbreviations		Skill Type Variable Names	
m	Management	autge	Authority/Management
k	Knowledge	cogn	Cognitive
d	Data	comm	Communication
a	Data Administration	fmotr	Fine Motor
s	Service	gmotr	Gross Motor
c	Skilled Goods		
g	Other Goods		

Table B.2

Discriminant Analysis				
500 Observations		499 DF Total		
5 Variables		493 DF Within Classes		
7 Classes		6 DF Between Classes		
Class Level Information				
FNLCLASS	Frequency	Weight	Proportion	Prior Probability
a	44	44.0000	0.08800	0.142857
c	89	89.0000	0.178000	0.142857
d	67	67.0000	0.134000	0.142857
g	190	190.0000	0.380000	0.142857
k	37	37.0000	0.074000	0.142857
m	23	23.0000	0.046000	0.142857
s	50	50.0000	0.100000	0.142857

Appendix B (*cont.*)

Table B.3

Discriminant Analysis Within Covariance Matrix		
FNLCLASS	Convariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
a	5	-15.03563
c	5	-14.37752
d	5	-10.69508
g	5	-15.55637
k	5	-13.07408
m	5	-19.84043
s	5	-11.07282

Table B.4

Pairwise Generalized Squared Distances Between Groups							
$D^2(i\|j) = (\overline{X}_i - \overline{X}_j)' \, cov_j^{-1} (\overline{X}_i - \overline{X}_j) + \ln\|COV_j\|$							
Generalized Squared Distance to FNLCLASS							
From FNLCLASS	a	c	d	g	k	m	s
a	-15.03563	84.93649	-1.20324	21.15721	79.57613	57.60192	-5.65667
c	20.31782	-14.37752	-5.28159	16.27090	17.91066	79.81764	-6.38613
d	20.21628	16.85753	-10.69508	43.58156	1.14144	55.11061	-4.81617
g	11.61060	39.09767	12.23538	-15.55637	164.78636	262.80054	-8.27852
k	72.20073	53.87274	-6.24134	57.99370	-13.07408	135.64394	9.47563
m	-4.14269	43.66065	-7.81138	102.14316	-2.55934	-19.84043	-3.51977
s	-1.06167	71.21607	5.57414	3.89895	130.59709	129.20598	-11.07282

Appendix B (*cont.*)

Table B.5

Posterior Probability of Membership in FNLCLASS								
SOC from FNLCLASS	Classified into FNLCLASS	a	c	d	g	k	m	s
1146 m	d	0.0005	0.0014	0.5122	0.0000	0.0000	0.4380	0.0480
1174 d	m	0.5803	0.0000	0.0258	0.0000	0.0001	0.9223	0.0015
1175 d	m	0.0022	0.0000	0.4057	0.0000	0.0001	0.5598	0.0322
2160 d	k	0.0000	0.0000	0.2306	0.0000	0.6858	0.0502	0.0334
2333 d	a	0.8889	0.0000	0.0574	0.0000	0.0000	0.0016	0.0520
2341 k	m	0.0000	0.0000	0.0060	0.0000	0.0019	0.9910	0.0011
23343 k	m	0.0020	0.0000	0.0123	0.0000	0.0040	0.9812	0.0004
2351 k	d	0.1522	0.0000	0.5113	0.0000	0.3343	0.0000	0.0022
2359 d	k	0.0003	0.0000	0.3374	0.0000	0.6182	0.0000	0.0441
2391 d	m	0.0064	0.0000	0.1307	0.0000	0.0004	0.8539	0.0086
2399 d	m	0.0099	0.0000	0.0273	0.0000	0.0001	0.9603	0.0024
2511 d	m	0.0000	0.0000	0.0344	0.0000	0.0004	0.9606	0.0046
2513 s	m	0.0000	0.0000	0.0344	0.0000	0.0004	0.9606	0.0046
2519 s	m	0.0672	0.0000	0.1239	0.0000	0.0176	0.7667	0.0247
3115 d	k	0.0000	0.0000	0.0324	0.0000	0.9676	0.0000	0.0000
3158 s	c	0.0000	0.9916	0.0022	0.0018	0.0000	0.0000	0.0044
3162 s	g	0.0064	0.0000	0.0361	0.6704	0.0000	0.0000	0.2872
3169 d	g	0.0064	0.0000	0.0361	0.6704	0.0000	0.0000	0.2872
3313 d	k	0.0000	0.0000	0.0890	0.0000	0.9040	0.0000	0.0070
3334 d	c	0.0000	0.7150	0.1141	0.0000	0.0000	0.0000	0.1710
3335 d	m	0.0035	0.0844	031143	0.0000	0.0002	0.7760	0.0216
3351 k	d	0.1284	0.0000	0.5411	0.0000	0.3102	0.0037	0.0166
3371 d	a	0.8072	0.0000	0.0178	0.0044	0.0000	0.0000	0.1706
5135 a	s	0.4152	0.0000	0.0470	0.0000	0.0000	0.0000	0.5378
5145 s	g	0.0000	0.0000	0.0000	0.8568	0.0000	0.0000	0.1432
5174 a	d	0.1381	0.0000	0.5741	0.0000	0.0000	0.0013	0.2864
5191 d	s	0.0000	0.0000	0.4331	0.0000	0.0000	0.0000	0.5669
6111 s	d	0.0000	0.0909	0.8003	0.0000	0.0000	0.0000	0.1088

Appendix B (*cont.*)

Table B.5 (*cont.*)

		Posterior Probability of Membership in FNLCLASS						
SOC from FNLCLASS	Classified into FNLCLASS	a	c	d	g	k	m	s
6120 s	m	0.1378	0.0001	0.1187	0.0000	0.0000	0.7148	0.0286
6129 s	d	0.0595	0.0000	0.6779	0.00062	0.0000	0.0000	0.2564
6130 s	d	0.2303	0.0000	0.3834	0.0000	0.0000	0.1218	0.2645
6133 s	g	0.0000	0.0000	0.0000	0.5369	0.0000	0.0000	0.4631
6141 d	s	0.0001	0.0000	0.0485	0.0014	0.0000	0.0000	0.9501
6160 g	m	0.1610	0.0000	0.1014	0.0000	0.0000	0.7140	0.0235
6190 s	a	0.8016	0.0000	0.1560	0.0000	0.0000	0.0236	0.0188
6198 s	g	0.0000	0.0000	0.0000	0.9750	0.0000	0.0000	0.0250
6199 s	g	0.0000	0.0000	0.0000	0.9655	0.0000	0.0000	0.0250
7311 c	d	0.0000	0.3203	0.6775	0.0000	0.0000	0.0000	0.0022
7516 g	d	0.0000	0.0000	0.6031	0.0003	0.0000	0.0000	0.3966
8546 c	s	0.0000	0.0854	0.0078	0.1042	0.0000	0.0000	0.8027
8719 g	s	0.0000	0.0000	0.0000	0.2276	0.0000	0.0000	0.7724
8786 g	s	0.0000	0.1152	0.0028	0.0788	0.0000	0.0000	0.8032
8796 c	d	0.0000	0.1419	0.5101	0.0359	0.0000	0.0000	0.0001
9110 d	c	0.0000	0.9979	0.0019	0.0000	0.0000	0.0000	0.0001
9113 d	a	0.7658	0.0000	0.1168	0.0000	0.0000	0.0000	0.1174
9139 g	s	0.2312	0.0000	0.0000	0.0179	0.0000	0.0000	0.7508
9159 g	s	0.0017	0.0000	0.0029	0.1044	0.0000	0.0000	0.8910
9179 g	s	0.0002	0.0000	0.0002	0.3526	0.0000	0.0000	0.6470
9319 g	s	0.0000	0.0000	0.0000	0.1130	0.0000	0.0000	0.8870
9531 c	g	0.0000	0.0064	0.3248	0.6174	0.0000	0.0000	0.0514
9555 c	g	0.0000	0.0064	0.3248	0.6174	0.0000	0.0000	0.514
9559 c	g	0.0000	0.1420	0.1367	0.4330	0.0000	0.0000	0.2883

Appendix B (*cont.*)

Table B.6

Generalized squared distance function

$$D_j^2(X) = (X - \overline{X}_j)' COV_j^{-1} (X - \overline{X}_j) + \ln|COV_j|$$

Posterior Probability of Membership in each FNLCLASS

$$Pr(j|X) = \exp(-.5D_j^2(X)) \;/\; \underset{k}{SUM} \exp(-.5D_k^2(X))$$

Number of Observations and Percent Classified in each FNLCLASS

From FNLCLA	a	c	d	g	k	m	s	Total
a	42 95.45	0 0.00	1 2027	0 0.00	0 0.00	0 0.00	1 2027	44 100.00
c	0 0.00	83 93.26	2 2.25	3 3037	0 0.00	0 0.00	1 1.12	89 100.00
d	3 4.48	2 2.99	46 68.66	1 1049	6 8.96	7 10.45	2 2.99	67 100.00
g	0 0.00	0 0.00	1 0.53	182 95.79	0 0.00	1 0.53	6 3.16	190 100.00
k	0 0.00	0 0.00	2 5.41	0 0.00	33 89.19	2 5.41	0 0.00	37 100.00
m	0 0.00	0 0.00	1 4.35	0 0.00	0 0.00	22 95.65	0 0.00	23 100.00
s	1 2.00	1 2.00	3 6.00	6 12.00	0 0.00	3 6.00	36 72.00	50 100.00
Total Percent	46 9.20	86 17.20	56 11.20	192 38.40	39 7.80	35 7.00	46 9.20	500 100.00
Priors	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429	

Table B.7

Error Count Estimates for FNLCLASS

	a	c	d	g	k	m	s	Total
Rate	0.0455	0.0674	0.3134	0.0421	0.1081	0.0435	0.2800	0.1286
Priors	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429	

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